

Study on Textural, Microbial and Sensory Quality of Blast Frozen Pangasius Fish Fillets Under Frozen Storage

Studi Kualitas Tekstur, Mikroba dan Sensori Fillet Ikan Pangasius Blast Frozen dalam Penyimpanan Beku

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Abstract

Pangasius fish is one of the rapid growing fresh water species in aquaculture. This study was aimed to assess the microbial number, physical quality and sensory evaluation of the *Pangasius* fish fillets from Nepal. *Pangasius* fish were collected from Chitwan and Nawalparasi districts, fillets were prepared and blast frozen simultaneously. The microbial number decreased rapidly during storage in frozen condition while *Staphylococcus aureus* and *Escherichia coli* (which were present initially in fillets) disappeared during storage. The sensory panellists preferred air blast frozen fillets stored for one month than stored for two months. Different parts of the fish body showed different textural properties. Hardness was increased during second month of storage while other textural properties were found satisfactory in first month of storage in frozen condition. This study showed that sensory qualities of air blast frozen *Pangasius* fish fillets changes with time even in frozen storage.

Keywords: fillet, microbial number, *Pangasius*, sensory, texture

Abstrak

Ikan Pangasius adalah salah satu spesies ikan air tawar yang dapat tumbuh cepat saat dibudidayakan. Penelitian ini bertujuan untuk menilai kualitas mikroba, kualitas fisik dan evaluasi sensorik dari fillet ikan *Pangasius* di Nepal. Ikan *Pangasius* didapatkan dari daerah Chitwan dan Nawalparasi, difillet dan dibekukan secara langsung. Jumlah mikroba menurun drastis saat penyimpanan dalam kondisi beku sedangkan *Staphylococcus aureus* dan *Escherichia coli* (yang memang ada di fillet sejak awal) tidak ada selama penyimpanan. Panelis sensoris lebih memilih fillet ikan dengan pembekuan air blast yang disimpan selama satu bulan daripada dua bulan. Bagian tubuh ikan yang berbeda menunjukkan sifat tekstur fillet yang berbeda. Tingkat kekerasan fillet ikan meningkat saat penyimpanan bulan ke dua, sementara sifat tekstur yang lain paling diminati saat penyimpanan bulan pertama dalam kondisi beku. Studi ini menunjukkan bahwa kualitas sensoris fillet ikan *Pangasius* dengan pembekuan air blast berubah seiring waktu bahkan dalam penyimpanan beku.

Kata kunci: fillet, jumlah mikroba, *Pangasius*, sensori, tekstur

INTRODUCTION

Pangasius (*Pangasius hypothalamus*) is a type of catfish belong to the family Pangasiidae and is also known as Sutchi catfish, striped catfish or Tra fish. Though, it is considered an endemic to the waters of Mekong basin in south-east Asia (Guimarães et al., 2016), its farming is considered as one of the fastest growing type of aquaculture in the world (Gurung et al., 2016). The fish rapidly attains body weight of 1.2 to 1.3 kg within a short period of 6 months. Usually, it is harvested after 8 months, depending on marketability (Gurung et

al., 2016). Rao, Murthy, & Prasad (2013) reported that the consumers preferred the fish due to its tender and white flesh, absence of fishy odour, firm cooked texture with high nutritive value with excellent sensory attributes.

Nepal being a landlocked country, aquaculture was an exotic concept and was only introduced in the 1940s with the introduction of several exotic carp species (FAO, 2016). Furthermore, fisheries has been considered as one of the major sub-sector for poverty reduction by the Government of Nepal in its 13th Plan (National Planning Commission, 2013) and had further em-

phasized to make Nepal a self-sufficient country in fish production by increasing its productivity from its current status 4.9 mt/hectare to 6.0 mt/hectare in its 15th Plan (National Planning Commission, 2017). The annual fish production of Nepal was 77,000 mt in 2017, where 55,500 mt was contributed by aquaculture (Ministry of Agricultural Development, 2017).

It is stated that the total production of *Pangasius* in the world is 1.6 million metric ton and it is dominated by the leading producer Vietnam, which solely produces approximately 81% of it. It has the high market in Europe. Nepal imports *Pangasius* from Vietnam, India and Bangladesh (FAO, 2012; Ramadhan, Suwandi, & Trilaksani, 2016). Because of having high correction factor, fast growth and adaptability to a wide range of culture conditions, *Pangasius* has the highest productivity in culture system. Initially, *Pangasius* was introduced by the Nepali Farmers themselves from India. Following its introduction, the Government of Nepal initiated research on breeding and rearing to fulfil the demand of fries at the local level (Sah et al., 2018). Following its farming and availability in the market, the demand for *Pangasius* is growing in Nepal due to its lower market price and presence of fewer spines in the flesh. These indicate that *Pangasius* has a potential market and if can be processed into value added products such as frozen fillets, can substitute the import.

Among different products of *Pangasius*, frozen fillets are the highly preferred product in the Nepali market. Fish fillets are simply the fleshy sides of the fish, cut lengthwise along the backbone, and either can be boneless or may contain pins (small bones). It may or may not have skin intact on the outside. These fillets are then frozen for marketing purpose. The flat shape and frozen state of fillets make packaging, storing, transporting and marketing much easier compared to fresh *Pangasius*.

At current, *Pangasius* farming is increasing yet, there is no industry which produces frozen *Pangasius* fillets in Nepal. Thus, this study was conducted with the main focus on the processing of frozen *Pangasius* fillets in the context of Nepal with the objectives to study the changes in textural properties, microbial number and sensorial quality during frozen storage.

METHODS

Pangasius fishes were collected from

Chitwan and Nawalparasi districts of Nepal. They were cleaned, degutted, deskin, deboned and then filleted. Then the fillets were blast frozen and stored at -18°C. The microbial number and textural properties along with sensory quality were studied on for two months.

Study of the Microbial Number of the Frozen Fillets during Storage

The microbial number of the fresh fillets in the beginning and frozen fillets at an interval of one month were analysed. Total Plate Count (TPC) was performed according to IS 5402:2012 (Bureau of Indian Standards, 2002a), Total coliform (TC) according to IS 5401:2012 (Bureau of Indian Standards, 2002b) and *E. coli* was enumerated according to IS 5887, Part I, 1976 (Bureau of Indian Standards, 1976). The presence of *Salmonella* and *Staphylococcus aureus* were determined according to FAO manual (FAO, 1992).

Study of Texture

The textural properties of the fresh fish and frozen fillets were studied using texture analyser (TA.XT Plus, Stable Micro Systems Ltd., UK). The texture of frozen fillets was studied at an interval of one month. For the study of texture profile, separate pieces having dimensions of L*B*T = 30 mm*30 mm*5 mm were taken from head, body and tail parts (Figure 1). The fish pieces were compressed to 20% of their original height at a constant speed of 0.5 mm/s. A diameter platen of 50 mm was used as probe for the study. Each analysis was done in duplicate. Texture profile analysis (TPA) was performed on force-time curves to calculate hardness, cohesiveness, springiness, resilience and chewiness.

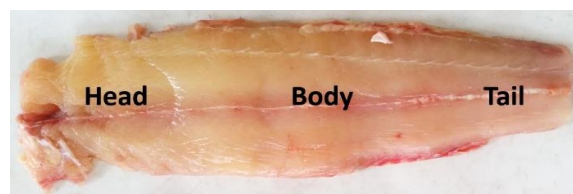


Figure 1. Fish Fillet Showing where the Pieces for Head, Body & Tail were taken from for Texture Analysis

Study of Sensory Properties of Frozen Fillets

The sensory properties along with texture profile were studied using untrained panellists every month for two months.

RESULTS AND DISCUSSION

Microbial Analysis of Fish Fillet Samples

The microbial number of the whole *Pangasius* fish, fish fillets and stored fillets were studied (Figure 2). Both the total plate count and coliform count were highest for the fillets which showed there remains the possibility of contamination during filleting. But both the total plate count and coliform count of the fillets decreased during frozen storage for two months. Ikasari &

Suryaningrum (2015) found the total plate count of 10^5 CFU/ml on the 18th day of storage in ice (0 – 4 °C). Lavanya et al. (2016) while studying antioxidant treated *Pangasius* fillets in frozen storage (-18 °C) for four months, reported an initial TPC of 10^3 CFU/g which gradually decreased during frozen storage. This research outcome is in accordance to her study as it showed that frozen storage of fillets lead to decrease in total coliform and total plate counts.

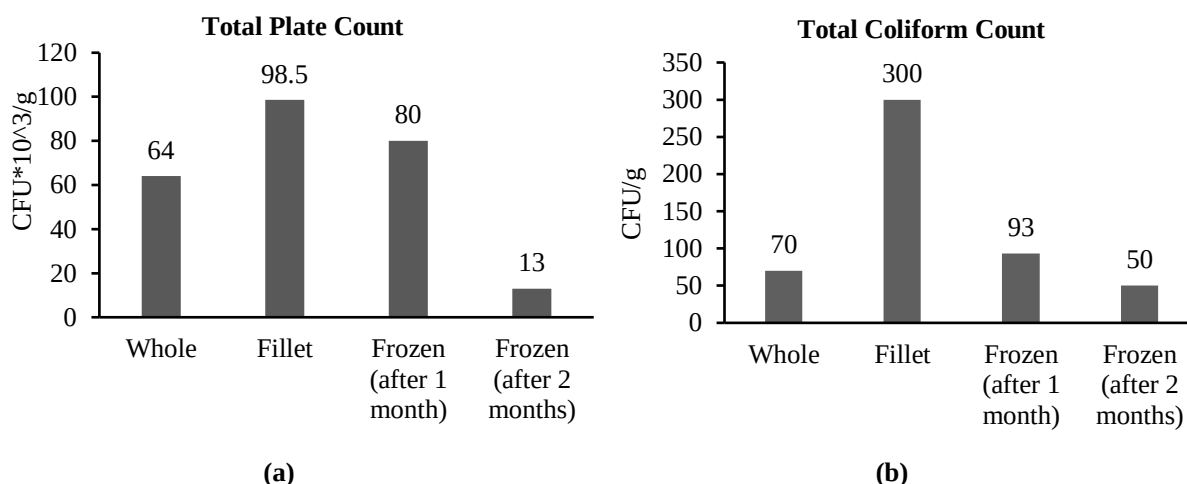


Figure 2. Changes in Total Plate Count (a) and (b) Total Coliform Count of *Pangasius* Fish Fillets during Storage (Freezing)

Table 1. Changes in the microbial load of *Pangasius* fish during storage (freezing)

Type	<i>Escherichia coli</i>	<i>Salmonella</i> spp	<i>Staphylococcus aureus</i>
Pangasius whole	Present	Absent	Absent
Pangasius fillet	Absent	Absent	Present
Frozen Pangasius fillet with skin (after 1 month)	Absent	Absent	Absent
Frozen Pangasius fillet with skin (after 2 months)	Absent	Absent	Absent

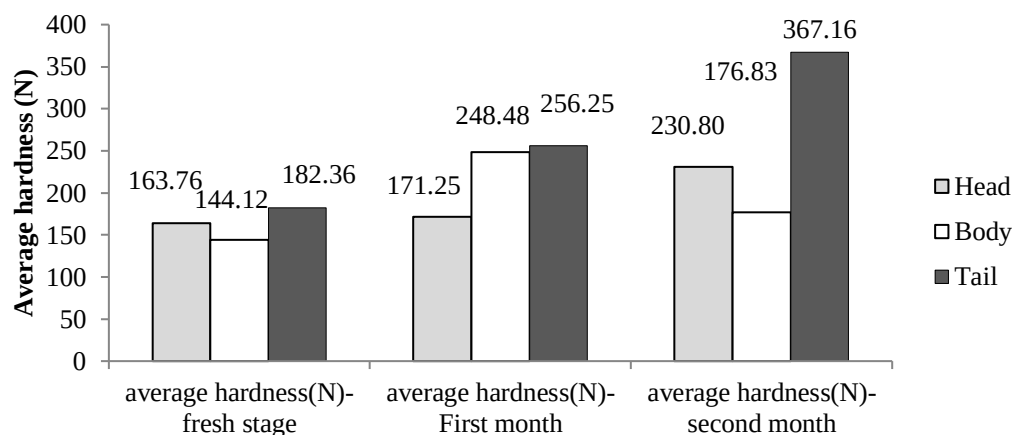


Figure 3a. Average Hardness Changes of *Pangasius* Fish Fillets Different Body Parts during Storage (Freezing)

Similarly, *Escherichia coli* was present initially in whole *Pangasius* fish but was neither detected on fish fillets nor on stored frozen fillets. *Salmonella* species were absent in all fish samples, whereas *Staphylococcus aureus* was detected in fresh fillets showing contamination while preparing fillets, however disappeared during frozen storage (Table 1).

Texture Analysis of Fish Fillet Samples

The changes in average hardness of the different body parts of *Pangasius* fish fillets during storage (in frozen condition) are presented in Figure 3a. The average hardness of the head and tail increased gradually during frozen storage for two months. But for body part, the average hardness increased in the first month while decreased in the second month. The reason for the increase of hardness in fish muscle can be the outcome of the polymer-polymer associations caused by partial dehydration and pressurizing effect of ice crystals production during frozen storage, which resulted in new aggregation promoting stronger super-junctions. Furthermore, it has been claimed that ice formation during frozen storage can lead to increased ionic strength in the unfrozen matrix forming more rigid network (Solo-de-Zaldívar et al., 2014). The decrease in the hardness of the body part in the second month of frozen storage can be the result of enzymes acting on proteins and forming breakdown metabolites, causing softness in fish proteins (Barraza, León, & Álvarez, 2015). The hardness of head and tail part of the fillet did not follow the

same trend as the body part. The difference can be because of less amount of muscle being contained by the head and tail part as compared to body part which in turn will have less active enzymes to act upon the proteins.

The changes in the average cohesiveness of different body parts of *Pangasius* fish during storage (freezing) are shown in Figure 3b. The average cohesiveness of head and tail of *Pangasius* fish fillets remain unchanged during first month but decreased during the second month of storage in frozen condition. The average cohesiveness of body decreased gradually during two months of storage in frozen condition than infresh fillets (Figure 3b). As cohesiveness represents the strength of the internal bonds of the fish fillets, the result showed that with the increase in hardness, cohesiveness decreased. Thus, these results are aligned with the result expressed by Barraza et al. (2015) as they also reported that the cohesiveness of Atlantic salmon under frozen storage decreased significantly with time.

The springiness of the different body parts of *Pangasius* fish fillets increased during the first month of storage in frozen condition while it decreased during the second month of storage (Figure 3c). Except for the tail part, highest springiness was observed during first month of storage under frozen condition. As springiness relates to the hardness of the fillets during the second bite, the results showed that the head and body parts of the fish fillets follow the same trend, while the tail part differed. Furthermore, the springiness of body and tail parts followed the

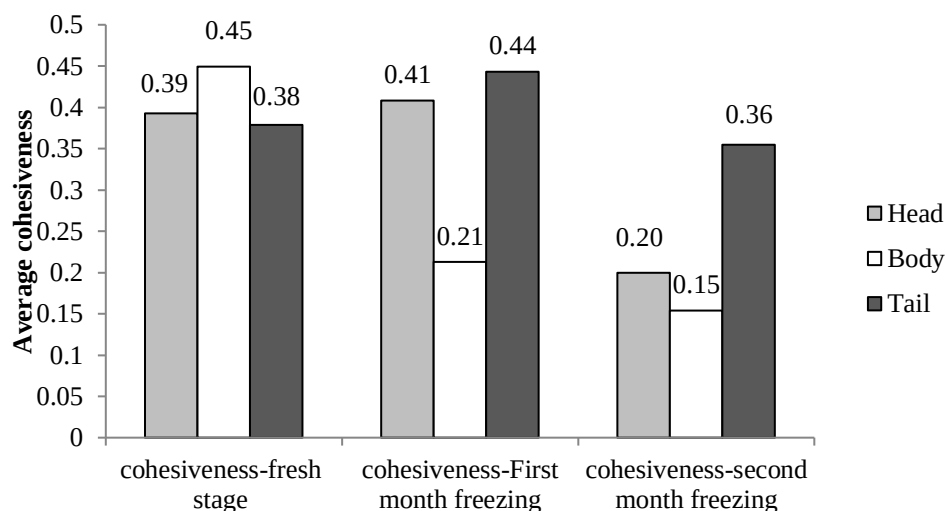


Figure 3b. Average Cohesiveness Changes of *Pangasius* Fish Fillets Different Body Parts during Storage (Freezing)

same trend, decrease in springiness of Atlantic salmon under frozen storage as reported by Barraza et al. (2015). The difference in the trend of springiness of tail part can be due to lower amount of muscle present as compared to head and body parts.

The average chewiness of head and body part of *Pangasius* fish during storage (freezing) increased in the first month of storage but decreased with increase in storage time. However, the average chewiness of tail part increased gradually throughout the frozen storage. The highest chewiness was observed in head part of the fish during first month of storage while lowest was observed in the body part of the fish during second month of storage (Figure 3d). Though chewiness is the product of hardness, cohesiveness and

springiness, the trend was found to be aligned more with the trend of springiness rather than hardness and cohesiveness.

The mean resilience of different body parts of *Pangasius* fish fillets during storage (freezing) is shown in Figure 3e. The average resilience of head part of the fish decreased during first month of storage but was reported to be increased during the second month of storage while that of body and tail increased during the storage. The highest resilience was observed in body part of the fish at the fresh stage while lowest was reported in tail part of the fish during second month of storage. As resilience shows how well a product regains its original position, the trend was found to be very much aligned with that of springiness.

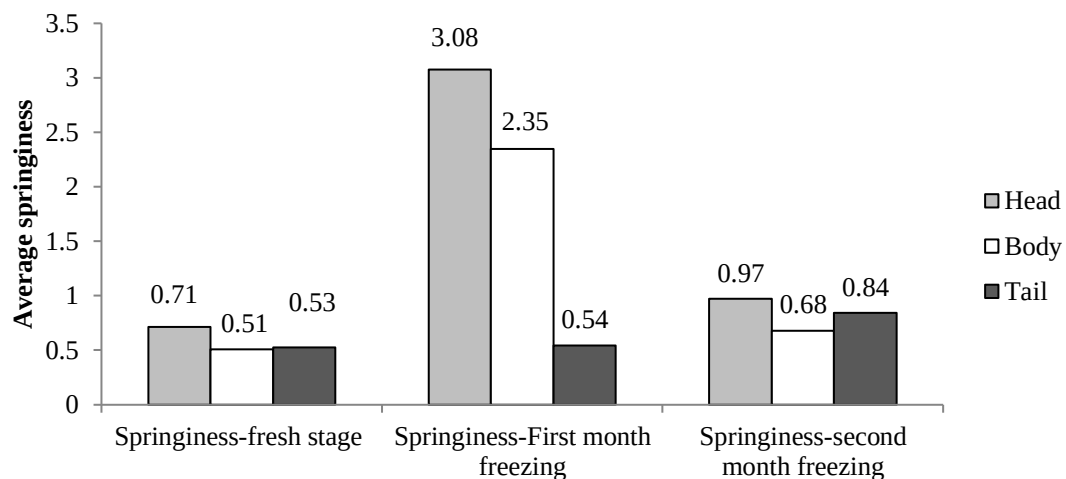


Figure 3c. Average Springiness Changes of *Pangasius* Fish Fillets Different Body Parts during Storage (Freezing)

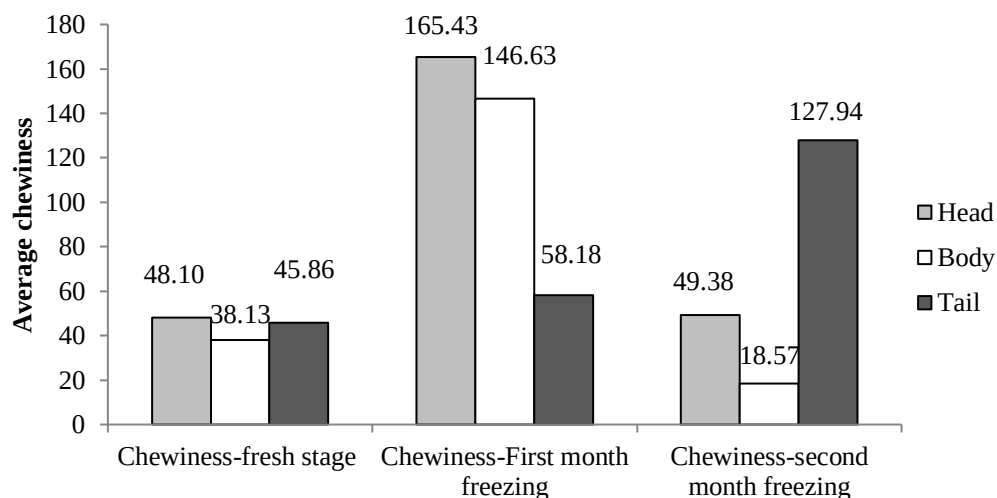


Figure 3d. Average Chewiness Changes of *Pangasius* Fish Fillets Different Body Parts during Storage (Freezing)

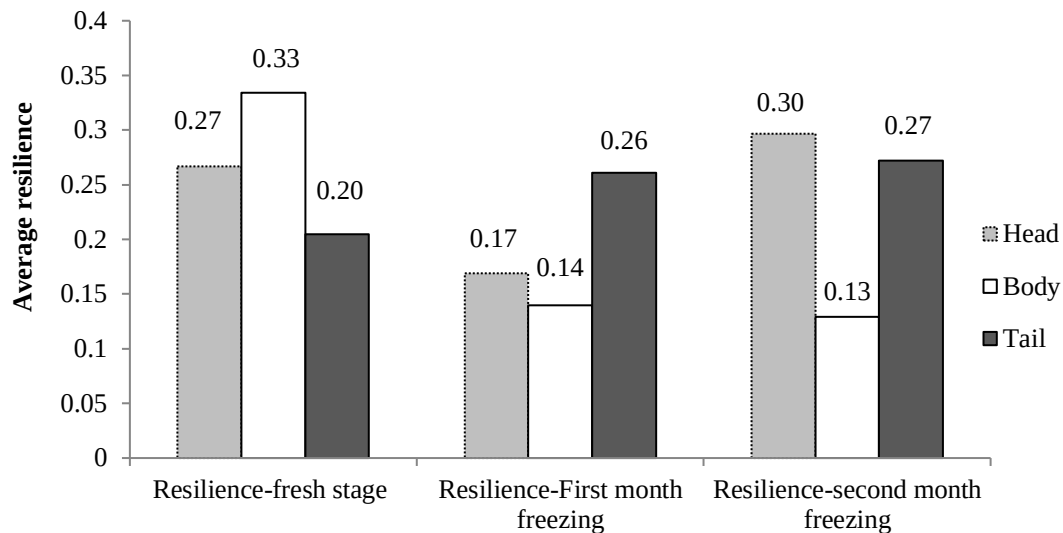


Figure 3e. Average Resilience Changes of *Pangasius* Fish Fillets Different Body Parts during Storage (Freezing)

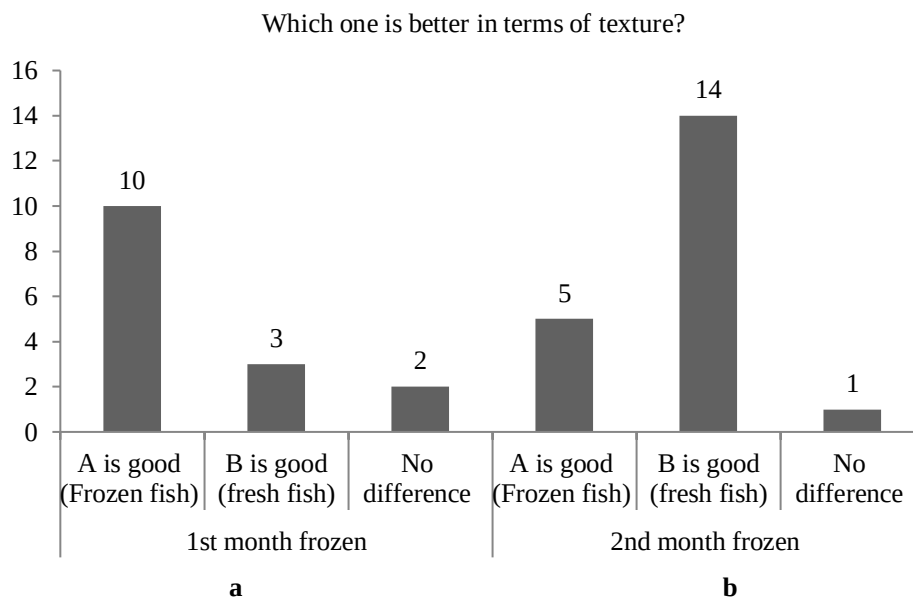


Figure 4. Sensory Evaluation of Frozen *Pangasius* Fish Fillets (In Terms of Texture) After 1st Month (A) & 2nd Month (B)

Sensory Analysis of Fish Fillet Samples

When paired comparison test was carried out for fresh *Pangasius* fillet and frozen *Pangasius* fillet (stored for one month) among fifteen number of untrained panellists, thirteen people (87%) reported differences between the two fish fillets (Figure 4a). Interestingly, on the basis of texture, higher number (67%) of panellists preferred frozen fish fillet to fresh fish fillet. Similarly, when similar test was carried out for after two months of frozen storage (Figure 4b), among twenty untrained panellists, nineteen people (95%) reported differences between them which was higher than for the one month frozen stored

fillets. Yet, in the second month, fourteen panelists (70%) preferred fresh fillet rather than frozen stored fillets.

This sensory evaluation showed that the texture of frozen *Pangasius* fillet was acceptable or rather preferred more than fresh fillet during the first month of frozen storage. Yet, the preferences of panellists drastically decreased with longer frozen storage of fillets. According to Ikasari & Suryaningrum (2015), the sensory evaluation of the fillets preserved in ice (0 – 4 °C), showed the fillets were acceptable only up to the 15th day. The fillets were rejected on the 18th day as change in colour, off-odour and mushy texture were

detected. A study done by Lavanya et al. (2016) showed frozen storage gradually decreased the acceptability of the product based on the sensory score.

CONCLUSION

Longer frozen storage of *Pangasius* fillets led to changes of textural properties along with sensory preferences. The textural properties analysis on hardness, cohesiveness, springiness and chewiness were in agreement with the sensory analysis result obtained from untrained panellists. These physical textural properties changed with the length of frozen storage, leading to increase in hardness and resilience but decrease in cohesiveness, springiness and chewiness over time. These results can be a promising guideline for interested entrepreneurs to process frozen fillets from *Pangasius* in Nepal. Furthermore, from the microbial study, it can be concluded that if taken proper precautions during the processing, post contamination with pathogenic micro-organisms can be avoided to produce safe fillets. Also, this result provides the basis for the acceptance of *Pangasius* fillets under frozen storage based on the textural properties.

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