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Sensory properties of sweet and spicy fish flakes using vinegar and water as pre-treatment

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ABSTRACT

Rays are usually caught for their high-value fins, but their flesh is also in demand in Philippine tribal areas. Compared to other commercial marine fish in the local market of Bongao, Tawi-Tawi, Philippines, stingrays are not very expensive, but they are high in protein. Fish flakes are a popular snack food made from intermediate moisture fish. This study evaluated sweet and spicy fish flakes made using dried stingray meat with the aid of white cane vinegar (T1) and water (T2) as pre-treatments. The newly developed fish flakes were evaluated by 100 panelists, particularly faculty and students. The results showed that the color, odor, texture, and general acceptability scores of sweet and spicy dried fish flakes did not differ significantly ($P>0.05$) between the two treatments. However, the taste scores showed a significant difference ($P<0.05$) in terms of sweetness. The sweetness score of sweet and spicy dried fish flakes pre-treatment with water (4.33 ± 0.09) was significantly higher than those pre-treatment with vinegar (3.99 ± 0.09). Moreover, the sensory quality scores suggest that either of the two treatments can be used to formulate this new fishery product. However, this new product requires further analysis, especially on shelf life, proximate and microbial analyses.

1. Introduction

Many aquatic resources are not the main livelihood, but they can be a food source for people. Thus, the development of new fishery product and convenience items in the Philippines have a brighter future (FAO, 2017). Cartilaginous fishes are important to humans in a number of ways, including as sources of food in European and Asian regions (Stehmann, 2002; Swastawati et al., 2012). Stingray is a member of the *Chondrichthyes* or "cartilaginous fish," a major class of jawed fish that includes the shark, rays, and skates; it feeds primarily on mollusks, crustaceans, and other small fishes (Ebert, 2003). Stingray recipes abound worldwide, with a dried form of wings being the most common. For example, in Singapore and Malaysia, stingray is commonly barbecued over charcoal, then served with spicy sambal sauce (Hutton, 2012; Karim, 2014; Lee, 2019). Southern Philippines do not consider stingrays high-quality food or part of their staple diets despite the fact that they are edible (Imbuk, 2023). However, they are consumed fresh, dried, and salted (McEachran, 2004).

A fish flake product has an intermediate moisture level with a brownish color, similar to the dried pork/chicken products known as "bak kua" in Malaysia (Mardiah et al., 2012). The "bak kua" is a sweet meat sandwich served with rice or bread and flavored with chilies or black pepper (Rao, 1997). A similar product, "dendeng", is processed from beef and is preserved by salt and sun drying (Mardiah et al., 2012). Due to the urea-smelling flesh of stingrays, fish flakes made from stingray meat are not so common. The South American version of fish flakes is called jerky, and for many years it has been a favorite snack (Carr et al., 1997). A jerky snack is made by marinating and drying sliced muscle from a large animal (Choi et al., 2008; Żochowska-Kujawska et al., 2017). The word jerky comes from the Spanish word "charqui," which means dried meat strips made from a variety of lean meats (Marchello, 1999; Jones et al., 2017). As a snack food, jerky has the advantages of being more convenient, maintaining its flavors, and serving as a good source of protein (Kumar et al., 2019). Additionally, the market has yet to be introduced to jerky that is made from stingray meat. A simple fish flake processing method reduces the urea odor of the stingray and gives it a specific flavor (Mardiah et al., 2012).

As a natural product, vinegar has been used for centuries as a cheap everyday condiment (Mazza & Murooka, 2009; Giudici et al., 2015). In meat and poultry processing, vinegar

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ingredients have long been appreciated as a way to tenderize, preserve, enhance flavor, minimize unwanted odors, and even change color (Barbut, 2015; Sarker et al., 2021). Stingrays sometimes require special treatment to realize their full potential in the food industry (Rosa et al., 2010). Biology-wise, the rays are very primitive, making use of their flesh to store uric acid to maintain a proper osmotic balance, which emits an ammonia smell after death (Haard, 2002). A report stated that skates and rays are prepared by soaking the meat in acidulated water before cooking to eliminate the smell or flavor of ammonia (Venugopal et al., 2002). These considerations inspired the researchers to formulate a new product from dried stingray meat to utilize food resources, including non-conventional ones. Knowing that in Tawi-Tawi, Philippines, the native fisherman have been very good at collecting stingrays and primarily sold in dried form in the local market. Thus, this study aims to assess the sensory qualities of the formulated sweet and spicy dried fish flakes and determine the best treatment by assessing the acceptability of the two treatments.

2. Materials and methods

2.1. Raw materials

The dried stingray (*Dasyatis khulii*) was purchased from the local market of Bongao, Tawi-Tawi. Then, it was transported to the Marine Integrated Laboratory (MIL) of Mindanao State University-Tawi-Tawi College of Technology and Oceanography (MSU-TCTO) College of Fisheries, Sanga-Sanga, Bongao, Tawi-Tawi, Philippines. The dried stingray was washed and cleaned immediately upon arrival at the laboratory. Then, it was cut into four equal parts and boiled until cooked.

2.2. Product formulation

Sweet and spicy dried fish flakes have two pre-treatments and focus on the product's flavor, texture, color, odor, and general acceptability. Figure 1 shows the process flow of sweet and spicy fish flakes. Five hundred grams of dried stingray meat was used per treatment. Treatment 1 was soaked in white cane vinegar (380 mL) until it was barely covered for 5 min, while treatment 2 was soaked in water (380 mL). The ingredients used were black pepper, garlic, onion, chili, sugar, salt, and cooking oil. All those ingredients were purchased from the local market. The weight of each ingredient is shown in Table 1.

2.3. Sensory evaluation

Sensory evaluation was performed at the end of the activities to determine the acceptability of the product. The evaluation was conducted at the Marine Integrated Laboratory (MIL) of the College of Fisheries. The product was evaluated by hundred (100) panelists, 30 faculty members (22 females and 8 males), and 70 students (45 females and 25 males) from the College of Fisheries, Tawi-Tawi, Philippines. The age of the student panelist ranges from 18-21 years old, while 26-50 years old for the panelist from the faculty members. Each sample treatment was placed on a separate plate, and the product was presented to each panelist on a clean, disposable plate. Additionally, bottled water was provided for them to drink before and after tasting. The score sheet for sweet and spicy fish flakes where patterned from the British Foundation Nutrition 2010. Product sensory characteristics (texture, odor, color, taste, and general acceptability) were scored using a 5-point hedonic scale test where 5=excellent, 4=very good, 3=satisfied, 2=good, and 1=poor.

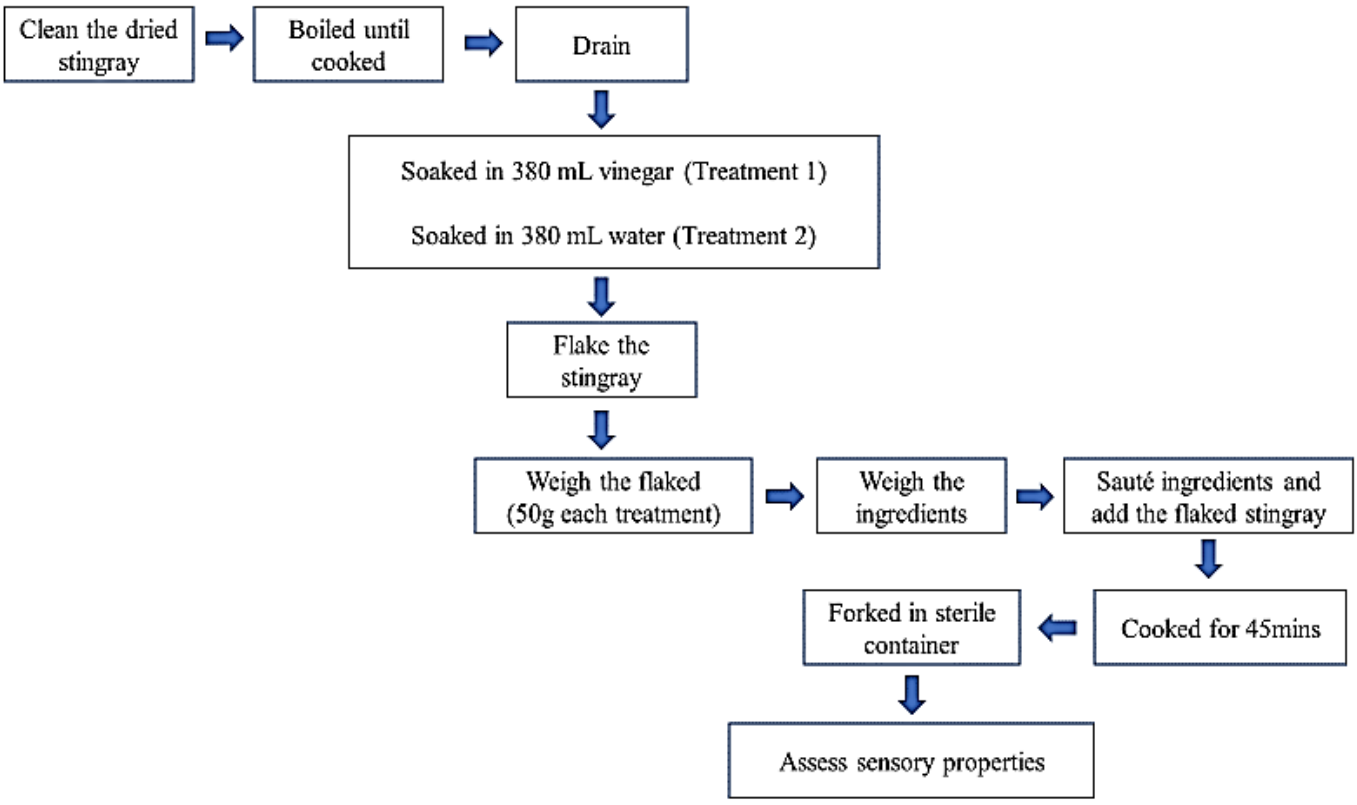

Figure 1. Process flow of sweet and spicy fish flakes

Table 1. List of ingredients using two different treatments

Ingredients	Treatment	
	Soaked in 380 ml vinegar	Soaked in 380 ml water
Dried stingray (g)	500	500
Black pepper (g)	20	20
Garlic (g)	60	60
Chili (g)	20	20
Onion (g)	60	60
Sugar (g)	120	120
Iodized salt (teaspoon)	1	1
Cooking oil (tablespoon)	10	10

2.3. Statistical analysis

IBM SPSS software version 20 was used to analyze the significance of differences between the two treatments' sensory characteristics (color, odor, taste, texture, and general acceptability) using an independent sample *t*-test. This study used a 0.05 significance level. Data were presented as mean ± SE (standard error).

3. Results

Color attributes scores of sweet and spicy fish flakes are shown in Figure 2. The brownish color of pre-treatment using vinegar (3.78 ± 0.12) was not significantly different (P>0.05) than pre-treatment using water (3.82 ± 0.13). Pre-treatment using vinegar (4.13 ± 0.10) was not significantly different (P>0.05) than using water (4.20 ± 0.10) in light brown color. In addition, the reddish color of fish flakes using vinegar (1.91 ± 0.13) did not differ significantly (P>0.05) from utilizing water (1.98 ± 0.13) as pre-treatment of fish flakes.

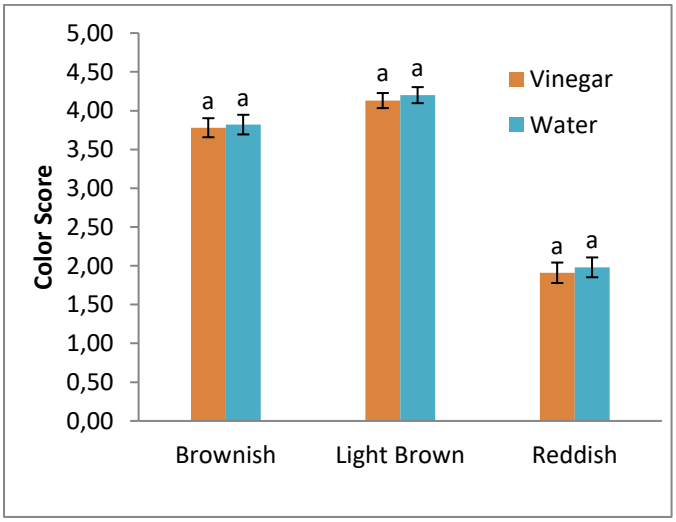

Figure 2. Color score of sweet and spicy fish flakes

The odor scores of sweet and spicy fish flakes pre-treated with vinegar and water are shown in Figure 3. The aromatic odor score of sweet and spicy fish flakes pre-treatment with vinegar and water was 3.95 ± 0.10 and 3.93 ± 0.11, respectively, showing no significant difference (P>0.05) between the two pre-treatment. Regarding its fishy odor scores, the fish flakes pre-treatment with vinegar was 2.83 ± 0.15, while the flake pre-treated with water was 2.73 ± 0.15 indicating no significant difference (P>0.05). Moreover, the pungent odor score of fish flakes using vinegar as pre-treatment was 2.44 ± 0.15, and 2.49 ± 0.15 for flakes pre-treated with water.

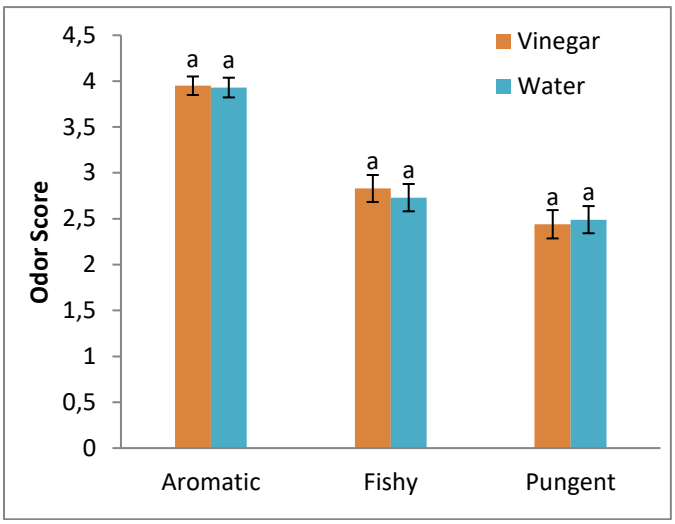

Figure 3. Odor score of sweet and spicy fish flakes

Texture scores of sweet and spicy fish flakes are shown in Figure 4. The brittleness score of pre-treatment using vinegar (3.08 ± 0.14) was not significantly different (P>0.05) than pre-treatment using water (3.05 ± 0.15). Pre-treatment using vinegar (3.45 ± 0.12) was not significantly different (P>0.05) than using water (3.62 ± 0.13) in terms of rubbery score. In addition, the firmness score of fish flakes using vinegar (3.20 ± 0.13) did not differ significantly (P>0.05) from utilizing water (3.30 ± 0.14) as pre-treatment of fish flakes.

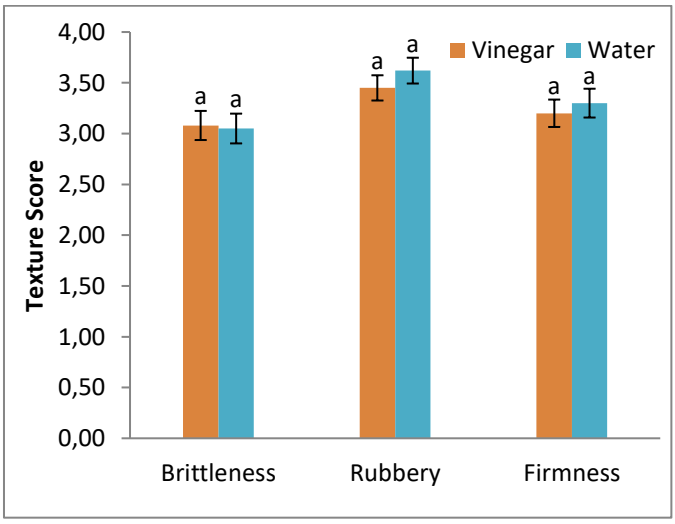

Figure 4. Texture score of sweet and spicy fish flakes

The taste scores of sweet and spicy fish flakes pre-treated with vinegar and water show no significant difference (P>0.05) in spiciness, sourness, and sweet and spicy scores but showed a significant difference (P<0.05) in terms of sweetness score (Figure 5). The sweetness score of sweet and spicy fish flakes pre-treatment with vinegar and water was 3.99 ± 0.09 and 4.33 ± 0.09, respectively, showing a significant difference (P<0.05) between the two pre-treatment. Regarding its spiciness scores, the fish flakes pre-treatment with vinegar was 4.32 ± 0.08, while the flake pre-treated with water was 4.24 ± 0.12 indicating no significant difference (P>0.05). Moreover, the sourness score of fish flakes using vinegar as pre-treatment was 2.20 ± 0.13, and 2.33 ± 0.15 for flakes pre-treated with water, indicating no significant difference (P>0.05). For sweet and spicy scores of fish flakes using vinegar (4.39 ± 0.09) did not

differ significantly (P>0.05) from water (4.34 ± 0.11) as pre-treatment of fish flakes.

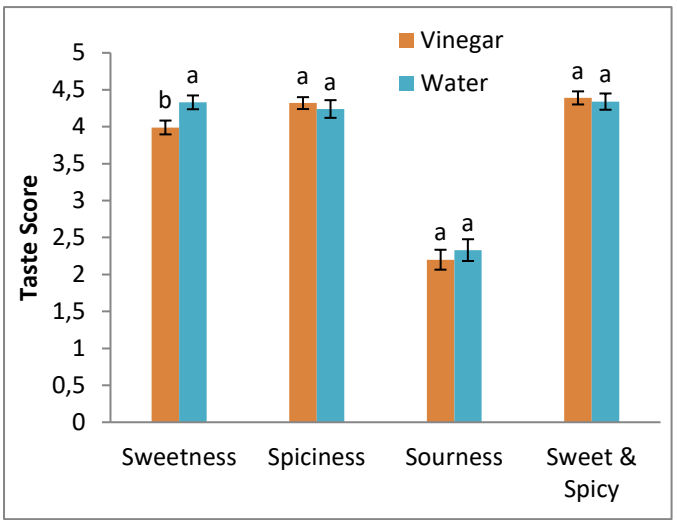

Figure 5. Taste score of sweet and spicy fish flakes.

The general acceptability scores of vinegar and water did not differ significantly (P>0.05) as pre-treatment of sweet and spicy fish flakes (Figure 6). The general acceptability score of sweet and spicy fish flakes pre-treatment with vinegar and water was 2.88 ± 0.20 and 2.69 ± 0.22, respectively.

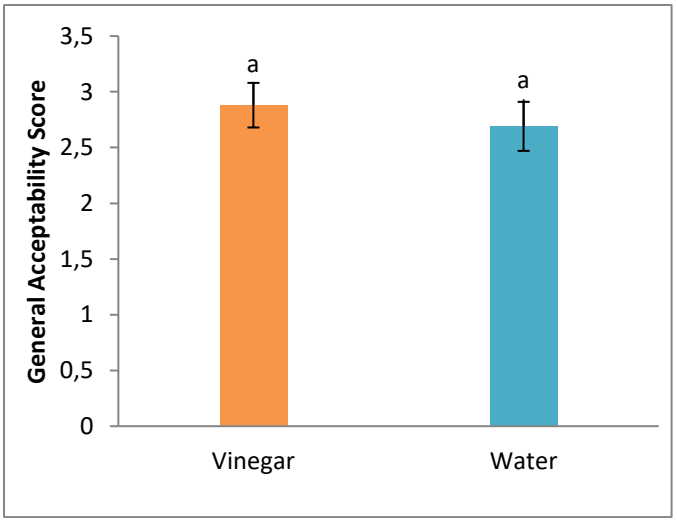

Figure 6. General acceptability score of sweet and spicy fish flakes

4. Discussion

There are many aquatic resources in the Philippines that are not the main source of livelihood, but they can provide food for humankind. Therefore, new fishery products and convenience items are promising in the Philippines (FAO, 2017). Stingray is one of the aquatic resources in the Philippines that is not considered a high-quality food and is not a staple food in any culture; however, stingrays are eaten fresh, dried, and salted (McEachran, 2004; Imbuk et al., 2023). Stingray meat is rare for making fish flakes because of its urea odor. A new product known as fish flakes, which are made from stingray meat, has yet to be introduced to the market. It is possible to reduce the urea odor and produce a fish flake that has a distinctive taste through a simple fish flake processing method (Mardiah et al., 2012). Sensory evaluation provides insight into the consumer's interpretation of the product (Stone et al., 2020). Fish flake quality is greatly impacted by sensory characteristics, such as colors, smells, tastes, textures, and overall acceptability, which differ from species to species and are affected by seasonal harvesting (Ainul et al., 2010). The present study evaluated the sensory properties of sweet and spicy fish flakes using dried stingray meat with the aid of vinegar and water as immersion solutions. According to the findings from this study, both vinegar and water positively impact the panelist on the sensory attributes, particularly color, odor, texture, and taste, as well as the overall acceptability of sweet and spicy fish flakes. It is known that customers' expectations are primed and formed by the color and appearance of a product prior to consumption, where the perception of "like" is lower than what was anticipated when the taste, odor, and flavor of a product are not accurately depicted by its visual representation, which is referred to as disconfirmation of expectations (Fiorentini et al., 2020). Hence, consumers must consider the overall appearance and other sensory attributes in order to influence how they perceive food products. A study conducted by Ainul et al. (2020) mentioned that flakes made from stingrays immersed in salt solution and prepared with different levels of tapioca starch had a positive impact on the product's sensory properties in terms of color, odor, taste, texture, and acceptability. Additionally, it was found that flakes made out of millet flour and snakehead fish "*koya*" mixed with skim milk, margarine, eggs, and water had improved sensory qualities in terms of color, flavor, aroma, texture, and overall acceptability (Anandito et al., 2021). Many researchers stated that pre-soaking fish in brine or water before cooking removed muddy or fishy flavors (Espejo-Hermes, 2004; Phu et al., 2022). In addition to preserving fish or aquatic products and removing the unpleasant odor, vinegar also kills bacteria and increases their shelf life (Espejo-Hermes, 2004; Dwivedi et al., 2017; Sarker et al., 2021).

4. Conclusions

The sensory evaluation provides insight into the consumer's interpretation of a product. Fish flakes' quality varies from species to species and is greatly influenced by sensory characteristics. Based on the result of this study, either of these pre-treatments (vinegar and water) can positively impact the sensory attributes of sweet and spicy fish flakes when used as immersion solutions in formulating this new fishery product. However, in order to strengthen the quality of this new product, further tests are needed, notably on the shelf-life as well as proximate and microbial analyses.

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