Journal of Food Biosciences and Technology,
Islamic Azad University, Science and Research Branch, Vol. 15, No. 1, 93-105, 2025

The Effects of Steaming and Oven-Cooked on the Volatile Compounds in Fillets of Siberian Sturgeon (*Acipenser baerii*)

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Received: 16 March 2025 Accepted: 9 September 2025

ABSTRACT: This research was undertaken to investigate the impact of two cooking techniques, specifically steaming and oven-cooked, on the volatile compounds of Siberian sturgeon (*Acipenser baerii*). The methods of food preparation and the conditions under which cooking occurs, including temperature and duration, play a crucial role in enhancing the characteristics of the meat. Notably, these factors warrant careful consideration. In this study, the 2*2*2cm fillets were subjected to two cooking methods: steaming for 25 minutes, achieving a center temperature of 83.5°C, and oven cooking for 25 minutes, resulting in a center temperature of 76.2°C. Gas chromatography-mass spectrometry (GC-MS) analysis revealed the presence of 24 compounds in the raw samples and 37 compounds in the cooked samples. These compounds included a variety of classes such as aldehydes, hydrocarbons, alcohols, ketones, alkaloids, furans. Data collected from observations indicated that employing the oven method for cooking resulted in a greater production of flavor-enhancing compounds. The application of oven cooking is presented as the most effective method for preparing Siberian sturgeon fish fillet.

Keywords: Cooking Techniques, Heat Treatment, Sea Food, Sturgeon, Sensory attributes, Volatile Compounds.

Introduction

Sensory descriptors obtained through sensory evaluation offer essential flavor insights that are beneficial for both food manufacturers and consumers in the process of knowledge sharing (Li *et al.*, 2022). Flavor, produced by volatile compounds, constitutes one of the five essential human senses and is defined as a multifaceted sensory experience (Delwiche, 2023). The interplay between taste and aroma plays a crucial role in forming a comprehensive understanding of flavor (Lucherk, 2022), thereby increasing the overall attractiveness of meat products. The integration of human taste and flavor receptors marks a notable progress in the field of food sensory development. The attributes of natural taste and overall flavor are critical factors influencing consumers' purchasing choices (Felderhoff, 2020). The application of heat to meat results in the transformation of non-volatile compounds into volatile substances, which contribute to the meat's flavor profile (Bleicher, 2022). The primary processes

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involved in flavor development are a sequence of chemical reactions, notably the lipid and Maillard reactions. Fish represents a food source of significant nutritional value. It is infrequently eaten in its raw form and is typically prepared through various cooking methods prior to consumption. Heating serves as a prevalent technique in food processing, with heat being applied through methods such as boiling, cooking, roasting, frying, and grilling. These methods not only enhance the flavor but also extend the shelf life of the fish (Vilkova, 2022). Various thermal processing methods lead to significant differences in food quality, primarily due to the unique mechanisms of heat transfer involved. These differences notably influence food texture, the degree of oxidation, and overall flavor, among other aspects (Liu, 2024). Cooking is crucial for reducing nutrient loss in food while simultaneously improving the tenderness and overall appeal of meat. Methods like deep frying and air cooking enhance the texture, color, and flavor characteristics of the food (Zhu, 2023). Furthermore, the unique flavors produced during the cooking of seafood are particularly appreciated (Zhang, 2024).

Siberian sturgeon is recognized for its significant nutritional profile, comprising 17.8% protein, 9.5% fat, and 71.7% moisture content. In contrast, farmed Siberian sturgeon exhibits a higher protein content of 21%, alongside a reduced fat percentage of 1.4% and an increased moisture level of 76.8% (Raposo *et al.*, 2023). Typically, these fish range in length from 0.8 to 1 meter and weigh between 10 to 30 kilograms. This fish contains a considerable amount of fat, and as previously mentioned, the application of heat influences its diverse compounds, including those responsible for flavor and aroma, depending on the method of cooking (Sridonpai, 2022). This study aimed to evaluate the effects of two distinct cooking techniques—steaming and baking—on the volatile compounds of Siberian sturgeon (*Acipenser baerii*).

Materials and Methods

- ***Preparation of sturgeon Fillet***

Siberian sturgeon specimens were procured in a fresh state, and following a thorough washing, the head, intestines, viscera, fins, and tail were removed. The fillets obtained were subsequently divided into three separate groups at random. The first group acted as a control, representing the raw sample, while the second group underwent a steaming process, and the third group was prepared using an oven-baking method. Fillets, each measuring 2 cm on each side, were subjected to two different cooking techniques: steaming for 25 minutes, achieving a central temperature of 83.5°C, and oven baking for the same duration, which resulted in a central temperature of 76.2°C.

- ***Identification of volatile compounds by SPME-GC-MS***

The volatile compounds present in sturgeon meat were isolated through headspace-solid phase microextraction (HS-SPME) and subsequently analyzed using gas chromatography-mass spectrometry (GC-MS). A total of 6 grams of minced fish meat was introduced into a 25 ml vial, which was subsequently sealed with a PTFE cap. The vial was equilibrated at a temperature of 70°C for a duration of 15 minutes. Following this, a solid-phase microextraction (SPME) fiber was employed for 40 minutes to facilitate the extraction process using a divinylbenzene/carboxane/polydimethylsiloxane coating. Finally, the fiber was inserted into the entrance of the gas chromatograph. Volatile compounds were examined using Shimadzu QP2010SE gas chromatography-mass spectrometry (GC-MS) equipment with an internaldiameter TR-35MS column with 0.25 mm and 30 m in length, with a film thickness of 0.25 µm.

- ***Statistical analysis***

In the current investigation, the identification of compounds was conducted across three experimental groups: raw samples (control) and two groups subjected to cooking treatments. A comparative analysis was performed among these three, focusing on both the types of compounds present and their respective quantities.

Results and Discussion

The findings regarding the identification of volatile compounds in the raw sample of Siberian sturgeon fish (control group) are presented in Figure 1 and Table 1. A total of 24 volatile compounds were successfully identified within this group. The most prevalent compounds included Octanal (73.642 ng/g), Pentanal (72.034 ng/g), 1-Octen-3-ol (63.363 ng/g), and 1-Penten-3-ol (62.264 ng/g). Conversely, 2-Ethyl-furan (5.896 ng/g) was identified as the least abundant compound. The aforementioned compounds, Octanal, Pentanal, 1-Octen-3-ol, and 1-Penten-3-ol, were notably the most frequently detected in this analysis.

The findings regarding the identification of volatile compounds in the steamed sample of Siberian sturgeon are presented in Figure 2 and Table 2. A comprehensive analysis revealed a total of 37 volatile compounds within this category. Notably, all 24 compounds detected in the raw sample were also found in the steamed sample, with their concentrations exhibiting a significant increase relative to the control sample. Tridecane (194/762 ng/g), Octanal (189/2016 ng/g), Hexanal (175/334 ng/g), and 2,3-Pentanedione (171/141 ng/g) emerged as the most frequently identified compounds within this category. In contrast, (E)-2-Nonenal (6.255 ng/g) was recorded as the compound with the lowest detection level.

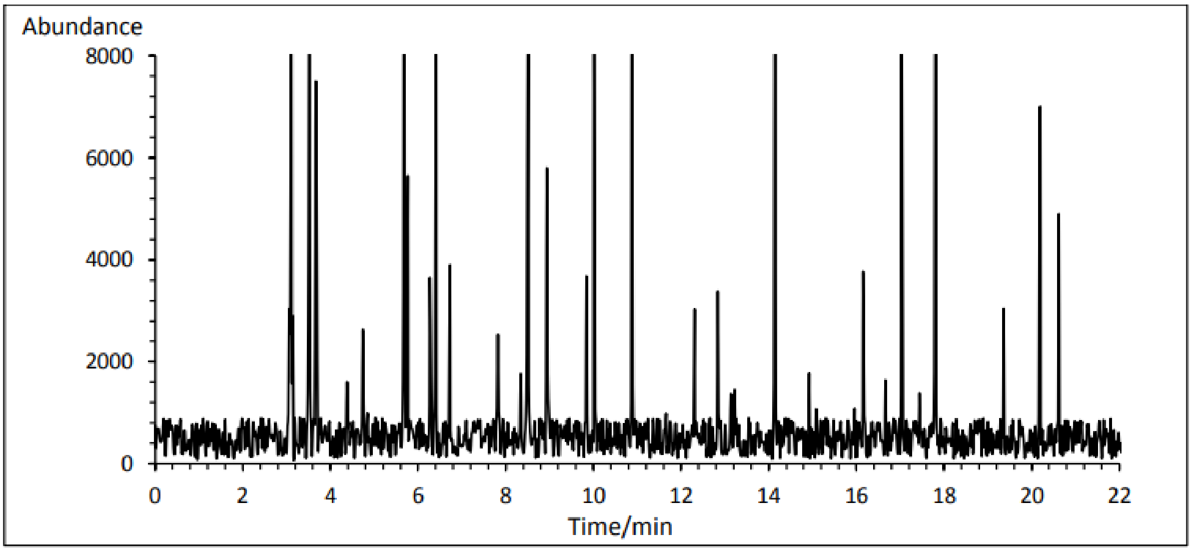

Fig. 1. Chromatogram of volatile compounds of raw Siberian sturgeon sample (control group)

Table 1. Volatile compounds identified in raw Siberian sturgeon sample (control group)

No	Peak IDs	Nature	RT (min)	Abundance (ng/g)
1	1-Penten-3-ol	Alcohols	3.11	62.264
2	2-Ethyl-furan	Furfuran	3.39	5.896
3	Pentanal	Aldehydes	3.52	72.034
4	2,3-Pentanedione	Aldehydes	3.67	50.014
5	(E)-2-Pentenal	olefine aldehyde	4.38	10.715
6	1-Pentanol	Alcohols	4.74	17.567
7	Hexanal	Aldehydes	5.68	89.224
8	3,5-Octadiene	Ketones	5.77	37.663
9	1-Hexanol	Alcohols	6.27	24.34
10	Heptanal	Aldehydes	6.21	60.011
11	Ethylbenzene	Aromatics (e1-e5)	6.73	26.016
12	Methoxy-phenyl-oxime	Alkaloid	7.82	16.911
13	2-Pentyl-furan	Furfuran	8.34	11.823
14	Benzaldehyde	Aldehydes	8.51	58.179
15	2,3-Octanedione	Ketones	8.64	38.684
16	6-Octen-2-one	Ketones	9.11	3.282
17	1-Heptanol	Alcohols	9.84	24.555
18	1-Octen-3-ol	Alcohols	10.01	63.363
19	Octanal	Aldehydes	10.88	73.642
20	3-Octen-2-one	Alcohols	11.66	6.607
21	2-Ethyl-1-Hexanol	Alcohols	12.31	20.245
22	Nonanal	Aldehydes	12.84	22.568
23	2-Octen-1-ol	Aldehydes	13.14	9.124
24	3,5-Octadien-2-one	Ketones	13.22	9.749

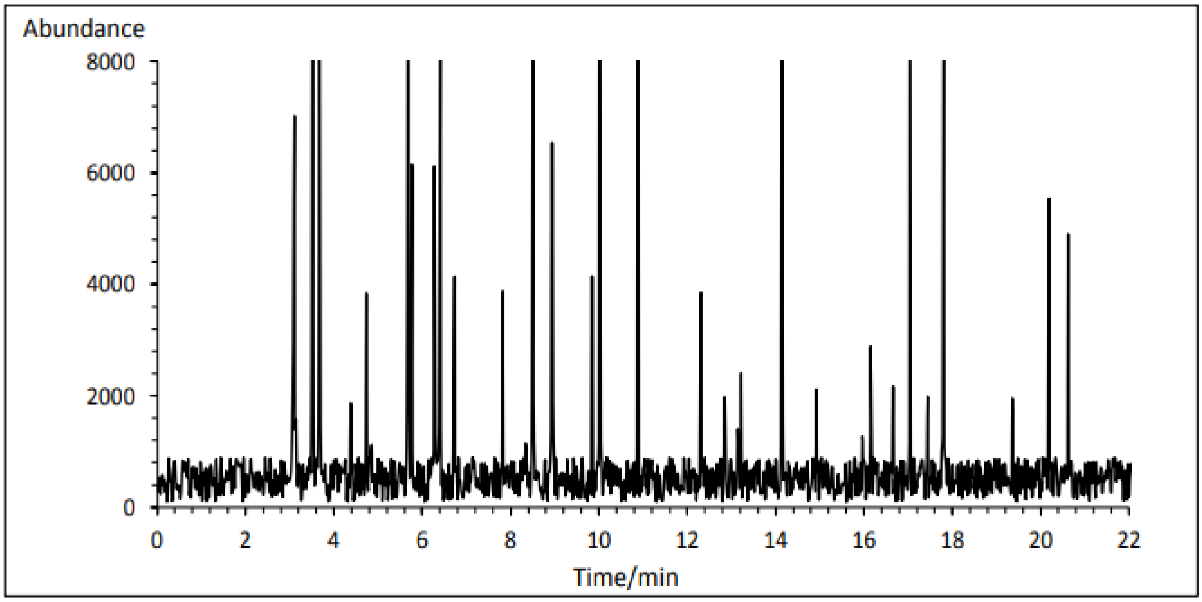

Fig. 2. Chromatogram of volatile compounds of steamed Siberian sturgeon fillets

Table 2. Volatile compounds identified in steamed Siberian sturgeon fillets

No	Peak IDs	Nature	RT (min)	Abundance (ng/g)	Changes compared to the control
1	1-Penten-3-ol	Alcohols	3.11	116.934	increase
2	2-Ethyl-furan	Furfuran	3.39	11.971	increase
3	Pentanal	Aldehydes	3.52	161.144	increase
4	2,3-Pentanedione	Aldehydes	3.67	171.141	increase
5	(E)-2-Pentenal	olefine aldehyde	4.38	31.155	increase
6	1-Pentanol	Alcohols	4.74	63.963	increase
7	Hexanal	Aldehydes	5.68	175.334	increase
8	3,5-Octadiene	Ketones	5.77	102.476	increase
9	1-Hexanol	Alcohols	6.27	101.895	increase
10	Heptanal	Aldehydes	6.21	135.427	increase
11	Ethylbenzene	Aromatics (e1-e5)	6.73	68.867	increase
12	Methoxy-phenyl-oxime	Alkaloid	7.82	64.628	increase
13	2-Pentyl-furan	Furfuran	8.34	19.027	increase
14	Benzaldehyde	Aldehydes	8.51	148.904	increase
15	2,3-Octanedione	Ketones	8.64	108.94	increase
16	6-Octen-2-one	Ketones	9.11	7.45	increase
17	1-Heptanol	Alcohols	9.84	68.936	increase
18	1-Octen-3-ol	Alcohols	10.01	157.299	increase
19	Octanal	Aldehydes	10.88	182.219	increase
20	3-Octen-2-one	Alcohols	11.66	14.327	increase
21	2-Ethyl-1-Hexanol	Alcohols	12.31	64.157	increase
22	Nonanal	Aldehydes	12.84	32.923	increase
23	2-Octen-1-ol	Aldehydes	13.14	23.377	increase
24	3,5-Octadien-2-one	Ketones	13.22	40.212	increase
25	Undecane	Hydro carbons	14.1	150.315	-
26	(E, Z)-2,6-Nonadienal	Aldehydes	14.92	35.157	-
27	(E)-2-Nonenal	Aldehydes	15.08	6.255	-
28	4-Ethyl-benzaldehyde	Aldehydes	15.96	21.27	-
29	Decanal	Aldehydes	16.15	48.116	-
30	2-(2-butoxyethoxy)-Ethanol	Alcohols	16.66	36.015	-
31	Dodecane	Hydro carbons	17.03	153.951	-
32	1,4-Oceadiene	Ketones	17.32	14.094	-
33	1-Tridecene	Hydro carbons	17.44	33.085	-
34	Tridecane	Hydro carbons	17.81	194.762	-
35	Pentadecane	Hydro carbons	19.36	32.519	-
36	Hexadecane	Hydro carbons	20.19	92.248	-
37	Heptadecane	Hydro carbons	20.62	81.579	-

The findings regarding the identification of volatile compounds in Siberian sturgeon prepared using the oven cooking method are presented in Figure 3 and Table 3. A total of 37 volatile compounds were detected in this sample.

Notably, all 24 compounds found in the raw sample were also present in the cooked sample, with their concentrations significantly elevated in comparison to the control sample. Additionally, the compounds identified through the cooking process were also detected in this group. With the exception of the compounds 2,3-Pentanedione, 1-Pentanol, 1-Hexanol, Methoxy-phenyl-oxime, 2-Octen-1-ol, 4-Ethyl-benzaldehyde, and 2-(2-butoxyethoxy)-Ethanol, all other compounds identified through this method exhibited an increase in concentration when compared to the steam cooking technique. The most prevalent compounds within this category were Tridecane (244/243 ng/g), Octanal (242/605 ng/g), and 1-Octen-3-ol (203/064 ng/g), in that order. Conversely, 6-Octen-2-one was the least detected compound, with a concentration of 14.785 ng/g.

The cooking process of meat involves a multitude of intricate chemical reactions that result in the generation of various volatile compounds, contributing to the characteristic aroma of meat. Key reactions responsible for the development of this aroma include lipid oxidation, the Maillard reaction, Strecker degradation, the breakdown of thiamine, carbohydrate degradation, and the interactions among the resultant products of these reactions. These processes culminate in the synthesis of a diverse array of organic compounds, such as hydrocarbons, alcohols, aldehydes, ketones, carboxylic acids, esters (including lactones), ethers, furans, pyridines, pyrazines, pyrroles, oxazoles, oxazolines, thiazoles, thiazolines, thiophenes, as well as various sulfur and halogen-containing compounds (Bleicher *et al.*, 2022).

Inorder to investigate the impact of various cooking techniques on the volatile compounds present in fish, gas chromatography-mass spectrometry (GC-MS) was employed to analyse the volatile profiles of raw fish samples subjected to different cooking methods, specifically oven and steaming. The analysis of the raw fish samples revealed the presence of a total of 24 distinct volatile compounds, which were categorized into six groups: 8 aldehydes (372.034 ng/g), 4 ketones (89.378 ng/g), 7 alcohols (217.172 ng/g), 2 furans (17.719 ng/g), 1 oleophenaldehyde (10.715 ng/g), and 1 aromatic compound (16.91 ng/g).

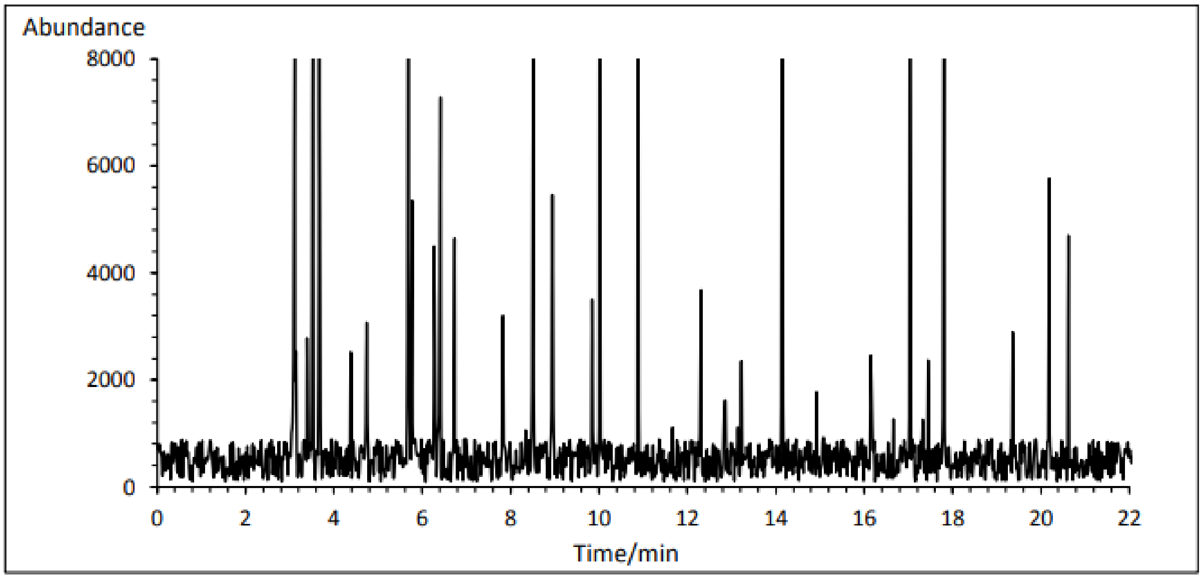

Fig. 3. Chromatogram of volatile compounds of oven-cooked Siberian sturgeon Fillets

Table 3. Volatile compounds identified in oven-cooked Siberian sturgeon fillets

No	Peak IDs	Nature	RT (min)	Abundance (ng/g)	Changes compared to the control	Changes compared to the Steam method
1	1-Penten-3-ol	Alcohols	3.11	182.781	increase	increase
2	2-Ethyl-furan	Furfuran	3.39	55.643	increase	increase
3	Pentanal	Aldehydes	3.52	181.775	increase	increase
4	2,3-Pentanedione	Aldehydes	3.67	163.15	increase	decrease
5	(E)-2-Pentenal	olefine aldehyde	4.38	50.316	increase	increase
6	1-Pentanol	Alcohols	4.74	61.462	increase	decrease
7	Hexanal	Aldehydes	5.68	219.673	increase	increase
8	3,5-Octadiene	Ketones	5.77	107.086	increase	increase
9	1-Hexanol	Alcohols	6.27	89.916	increase	decrease
10	Heptanal	Aldehydes	6.21	145.654	increase	increase
11	Ethylbenzene	Aromatics (e1-e5)	6.73	92.882	increase	increase
12	Methoxy-phenyl-oxime	Alkaloid	7.82	63.913	increase	decrease
13	2-Pentyl-furan	Furfuran	8.34	21.184	increase	increase
14	Benzaldehyde	Aldehydes	8.51	182.203	increase	increase
15	2,3-Octanedione	Ketones	8.64	109.2	increase	increase
16	6-Octen-2-one	Ketones	9.11	14.785	increase	increase
17	1-Heptanol	Alcohols	9.84	70.115	increase	increase
18	1-Octen-3-ol	Alcohols	10.01	203.064	increase	increase
19	Octanal	Aldehydes	10.88	242.605	increase	increase
20	3-Octen-2-one	Alcohols	11.66	22.177	increase	increase
21	2-Ethyl-1-Hexanol	Alcohols	12.31	73.576	increase	increase
22	Nonanal	Aldehydes	12.84	32.37	increase	decrease
23	2-Octen-1-ol	Aldehydes	13.14	22.345	increase	decrease
24	3,5-Octadien-2-one	Ketones	13.22	47.062	increase	increase
25	Undecane	Hydro carbons	14.1	198.425	-	increase
26	(E, Z)-2,6-Nonadienal	Aldehydes	14.92	35.479	-	increase
27	(E)-2-Nonenal	Aldehydes	15.08	18.503	-	increase
28	4-Ethyl-benzaldehyde	Aldehydes	15.96	17.661	-	decrease
29	Decanal	Aldehydes	16.15	49.222	-	increase
30	2-(2-butoxyethoxy)-Ethanol	Alcohols	16.66	25.271	-	decrease
31	Dodecane	Hydro carbons	17.03	169.197	-	increase
32	1,4-Oceadiene	Ketones	17.32	25.108	-	increase
33	1-Tridecene	Hydro carbons	17.44	47.43	-	increase
34	Tridecane	Hydro carbons	17.81	244.853	-	increase
35	Pentadecane	Hydro carbons	19.36	57.871	-	increase
36	Hexadecane	Hydro carbons	20.19	115.289	-	increase
37	Heptadecane	Hydro carbons	20.62	94.044	-	increase

A comprehensive analysis of the volatile compounds presents in the sample subjected to steaming revealed the identification of a total of 37 distinct volatile compounds. Notably, all 24 compounds detected in the raw sample were also found in the steamed sample, with their concentrations exhibiting an increase relative to the raw state. These 37 compounds can be categorized into eight distinct groups: 12 aldehydes (1045/745 ng/g), 5 ketones (273/222 ng/g), 5 alcohols (451/106 ng/g), 2 furans (30/998 ng/g), 1 oleophenaldehyde (30/998 ng/g), 1 aromatic compound (68.867 ng/g), and 7 hydrocarbons (738/459 ng/g).

A total of 37 volatile compounds were detected in the sample prepared using Avon's method. Notably, all 24 compounds found in the raw sample were also present in this cooked group, with their concentrations elevated in comparison to the control sample. These 37 compounds can be categorized into eight distinct groups: 12 aldehydes (2980/64 ng/g), 5 ketones (303/241 ng/g), 5 alcohols (728/325 ng/g), 2 furans (76/827 ng/g), 1 oleophenaldehyde (76/827 ng/g), 1 aromatic compound (abundance 92/882 ng/g), and 7 hydrocarbons (abundance 927/109 ng/g).

The findings indicate that the cooking processes employed for both methods resulted in an increase in aldehyde and ketone compounds when compared to the control group (raw sample). Additionally, the presence of hydrocarbon compounds was noted in samples prepared using both oven and steamer techniques. Notably, the steam cooking method yielded the highest concentration of aldehyde compounds. Research indicates that aldehydes significantly contribute to the flavor profile of meat, primarily arising from the oxidative breakdown of lipids present in the meat. These compounds possess a low detection threshold, which allows them to impart fruity, grassy, and various other aromatic qualities. They are integral to the distinctive flavors found in fish meat (Gu *et al.*, 2020). Furthermore, Zhang *et al.* (2023) demonstrated that aldehydes represent the predominant category of volatile compounds in silver carp fillets prepared using the steaming technique. Elevated levels of aldehydes, including Heptanal, Nonanal, Octanal, and Decanal, which impart a fatty flavor, were identified in meat prepared through steaming and oven cooking. This phenomenon is likely attributable to lipid oxidation (Li *et al.*, 2022). Furthermore, it has been noted that 1-Penten-3-ol possesses a complex aroma characterized by green, herbal, spicy, burnt, meaty, and plastic notes. This volatile alcohol compound may arise from the oxidation of eicosapentaenoic acid (EPA, C20:5n-3) facilitated by the action of 15-lipoxygenase and hydroperoxide lyases (Kawai and Sakaguchi, 1996). The compound 2,3-Pentanedione, a product of the Maillard reaction, is associated with sweet, buttery, caramel, and fruity aromas (Machiels *et al.*, 2004). Research conducted by Zardino *et al.* (2016) revealed that hexanal is the sole product generated from the oxidation of 9 to 13 linoleate hydroperoxide and other unsaturated aldehydes derived from linoleic and oleic acids. The increased concentration of hexanal observed in the steamed sample suggests a greater extent of oxidation occurring during the steaming process.

The findings indicated that various volatile compounds, including ketones, alcohols, furans, aromatic compounds, and hydrocarbons, predominated in the steam cooking method. The variations in compound compositions across different cooking methods may be attributed to the distinct heat transfer mechanisms, as well as the differing heating durations and temperatures employed under various cooking conditions (Sun *et al.*, 2022; Zheng *et al.*, 2022).

Alcohols typically arise from the oxidation of lipids and the reduction of sugars, amino acids, and carbonyl compounds. Due to their elevated taste threshold, alcohols contribute minimally to the overall flavor profile of Siberian caviar fish meat (Bassam *et al.*, 2022). The findings indicate that the concentration of alcohols in Siberian caviar meat is greater in oven-cooked samples compared to those that are steamed. The compounds (E)-2-pentenal and (E,Z)-2,6-nonadienal are produced through the action of 15-lipoxygenase and 12-lipoxygenase on omega-3 essential fatty acids and highly unsaturated fatty acids, respectively. The presence of these two compounds contributes to a scent reminiscent of cucumber in fish (Josephson and Lindsay, 1987). The levels of these substances increased significantly during the steaming process (31.155 and 35.157 ng/g, respectively) and in the oven (50.316 and 35.479 ng/g, respectively) when compared to the raw sample (50.316 and 35.479 ng/g, respectively). This increase may be attributed to the heightened susceptibility of unsaturated fatty acids to oxidative processes during thermal treatment (Biandolino *et al.*, 2023). Both 1-Hexanol and 1-Octen-3-ol were detected in the raw fish sample as well as in the cooked samples from both cooking methods, while a novel alcoholic compound, 2-(2-butoxyethoxy)-ethanol, was identified exclusively in the cooked samples. The elevated temperature during cooking leads to the breakdown of linoleic acid hydroperoxides in meat (Wang *et al.*, 2016). Consequently, the concentration of 1-Octen-3-ol in meat increases post-cooking. This compound, characterized by its doughy, earthy, and fishy aroma, is generated through the oxidation of arachidonic acid mediated by 12-lipoxygenase (Chen *et al.*, 2023). Additionally, 1-penten-3-ol may be synthesized via the enzymatic action of 15-lipoxygenase on eicosapentaenoic acid (EPA) (Mazhar *et al.*, 2020). Furthermore, 1-Hexanol can be formed through the activity of alcohol dehydrogenase (ADH) (Jia *et al.*, 2020). Research indicates that 1-Hexanol and 1-Octen-3-ol significantly contribute to the aroma profile of fish products, with elevated levels of these compounds resulting in a pronounced fishy odor (Iglesias *et al.*, 2009). Typically, alcohols are associated with a pleasant and fruity flavor. The flavor compounds found in fish flesh that are classified as alcohols primarily consist of fatty alcohols, which include both saturated and unsaturated varieties. These compounds are predominantly generated through the oxidation of unsaturated fatty acids during cooking (Sun *et al.*, 2023). An elevated threshold for saturated alcohols indicates a diminished contribution to the flavor profile of cooked meat, whereas a reduced threshold for unsaturated alcohols suggests a more pronounced influence, particularly regarding metallic and mushroom-like notes. Research conducted by Hang *et al.* (2017) demonstrated that the synthesis of the compound (E,Z)-2,6-nonadienal is associated with lipid oxidation that occurs during the cooking process. Their findings revealed that the concentration of (E,Z)-2,6-nonadienal in steamed fish samples was 19 times greater than that in raw samples.

Hydrocarbons primarily arise from the oxidative processes involving lipids present in meat, exhibiting a significant threshold value. The findings indicate that the concentration of hydrocarbons in

Siberian caviar can be ranked as follows: oven-cooked > steamed. The formation of hydrocarbons occurs via the radical hemolysis of fatty acids (Ni *et al.*, 2021). Hydrocarbon compounds encompass alkanes, olefins, and aromatic hydrocarbons. Saturated hydrocarbons typically exhibit a high sensory threshold and tend to exert minimal influence on the flavor profile of fish flesh (Fan *et al.*, 2020). Conversely, unsaturated hydrocarbons possess a comparatively lower threshold and significantly impact the taste of fish. Under specific conditions, hydrocarbon compounds can yield flavoring agents such as aldehydes, ketones, and alcohols, thereby contributing to the development of flavor in fish (Sun *et al.*, 2020). The temperature employed for steaming and baking varied from that of the oven. The distinct heating methods may have resulted in variations in the flavor profiles of the cooked Siberian sturgeon meat.

A total of eight distinct ketones were detected in the meat of Siberian fish. The concentration of these ketones in the fish meat can be ranked as follows: steamed > oven-cooked > raw. The compounds 3,5-Octadiene, 3,2-Octanedione, 6-Octen-2-one, and 3,5-Octadien-2-one were present in all samples, regardless of preparation method. Conversely, the ketone compound 1,4-Octadiene was exclusively found in the steamed and oven-cooked samples. Ketones are generated through the thermal oxidative degradation of unsaturated fatty acids or amino acids, which primarily yield flavors reminiscent of eucalyptus, fruit, and fat (Luo *et al.*, 2022). The sensory threshold for ketones is significantly elevated compared to that of aldehydes. This elevated threshold indicates that ketones have a minimal impact on the overall flavor profile of fish, although they may diminish the fish flavor (Cui *et al.*, 2020). Consequently, the increased levels of ketones found in oven-cooked fish suggest that the cooking method effectively mitigates the fishy taste associated with this type of meat. Additionally, the compound 2,3-Octanedione plays a role in enhancing the palatability of cooked fish. The formation of furan compounds, specifically 2-ethyl-furan and 2-ethyl-furan, results from the oxidative processes occurring in the fats present in fish (Iglesias and Medina, 2008).

Conclusion

In this research, the volatile compounds responsible for flavor in Siberian sturgeon (*Acipenser baerii*) fillets were analyzed, comparing those subjected to steaming and oven cooking with the raw samples. Overall, the various cooking techniques employed in this investigation markedly altered the composition of volatile compounds in the fillets of Siberian sturgeon. A comprehensive analysis of volatile compounds revealed the presence of 24 distinct aldehydes, ketones, furans, oleophenaldehydes, and aromatic compounds in the raw sample. In contrast, a total of 37 compounds were detected in both oven-cooked and steamed samples. Notably, in addition to the compounds identified in the raw sample, there was a significant increase in the presence of alkaloids and hydrocarbons in the cooked samples. The findings indicated that the steam cooking method yielded the highest concentration of aldehyde compounds, whereas the oven-cooked samples exhibited a greater concentration of other volatile compounds.

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