# Analysis of Fishy Components in Edible Parts of Golden Pompano

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**Abstract.** The volatile components of fillets, skin and mucus on the surface from golden pompano was analyzed by headspace solid phase micro-extraction (HS-SPME) - gas chromatography-mass spectrometry (GC-MS). A total of 57 volatile components were identified from the fillets, skin and mucus of golden pompano, including 8 alcohols, 13 aldehydes, 2 ketones, 2 esters, 30 hydrocarbons and 2 others. The amount of alcohols, aldehydes, ketones, esters and other volatile components in mucus was more than that in fillets and skin. Fully removing the mucus on the surface from golden pompano, there will be less fishy smell in fish skin and fillets. It is suggested that there may be no migration pathway of fishy odor components from water to mucus, skin to fish.

**Keywords:** fishlike smell, Pomelo fillet, mucus, paracellular transmigration.

## 1. Introduction

The flavor of aquatic products has an important influence on its edible quality, processing characteristics and commodity value. Flavor components are mainly composed of volatile compounds (alcohols, aldehydes, ketones, acids, phenols and other low molecular weight compounds) and non-volatile compounds (amino acids, small molecular peptides, sugars and other flavor components) [1]. Volatile flavor components are the substances perceived by the sense of smell, which play a key role in the flavor of products. And flavor components are the direct factors affecting consumers' acceptance of products. In recent years, a large number of researchers have focused on the volatile flavor components of fish and shellfish and other aquatic products.

It is well known that people don't like freshwater fish so much, mainly because of earthy and fishy smell of fish. So the fishy smell of fish has been studied. It is reported that the volatile compounds of the dorsal meat, belly meat, red meat, skin, intestines and gills of grass carp were analyzed by gas chromatography-mass spectrometry and the electronic nose[2]. Although the flavors of the red meat, skin, intestines and gills could be distinguished by the electronic nose, the dorsal and belly meat could not be distinguished. The fishy smell detected from weakest to strongest were: dorsal meat/belly meat , red meat, fish skin, fish intestines and fish gills. There were volatile components present in different parts of grass carp. At the same time, different parts (the dorsal meat, belly meat, dark meat, skin, intestines, and gills) of grass carp were analyzed by comprehensive two-dimensional gas chromatography coupled with time-of-flight mass spectrometry (GC×GC-TOFMS). The fishy smells were also identified, from weakest to strongest to: belly/dorsal meat, dark meat , skin, intestines and gills. Most volatile components were mainly aldehydes and alcohols, including: hexanal, octanal, nonanal, heptanal, decanal, 1-heptanol, 1-octen-3-ol, 2,4-decadienal and (e,e)-2,4-nonadienal[3]. It is suggested that there was less fishy smell in fish skin and fish meat.

In recent years, there have been many reports on the study of the volatile flavor of aquatic products. It is found that different varieties, breeding areas and harvest seasons have important effects on the volatile components of oysters. The difference of volatile components among varieties was mainly caused by 1,5-octadiene-3-alcohol and 3-cyclohexene-1-ethanol. The difference of volatile components in the breeding range was mainly caused by 1-penten-3-one, n-hexane and syringaldehyde. The main volatile components of European oyster were 3-cyclohexene-1-ethanol, and those of Pacific oyster were 1,5-octadiene-3-alcohol[4].

Headspace solid phase micro-extraction (HS-SPME) - gas chromatography-mass spectrometry (GC-MS) has been widely used to investigate volatile components of aquatic products.The headspace solid phase microextraction conditions (type of extraction head, sample volume, extraction time and extraction temperature) have been studied. It was found that volatile components were extracted most effectively and accurately at 80 ℃ for 30 minutes. Then using this method, 22 volatile components were identified from fresh oysters in Spain[5].

Fishy smell is a bad flavor that affects the quality of aquatic products. Some researchers believed that the breeding environment contributed to the bad flavor of aquatic products. For example, some studies believed that fish gills contain a lot of fishy components. However, we believe that it is valuable to study the volatile flavor components in the edible parts of fish, because only the edible parts such as fish meat and skin will be used in processing, and the gills and scales will be discarded.

Many studies have shown that there are differences in volatile components between fish skin and fish meat [6-7]. The mucus on the surface of fish is in close contact with the breeding environment, and its volatile components may have an important impact on the flavor quality of fish meat or skin. Therefore, the volatile flavor components in fish meat, fish skin and mucus will be explored to judge the differences of fishy components in these parts, and analyze whether there is a migration path of fishy components from aquaculture environment to fish mucus, from fish skin to fish meat. This study will provide a theoretical basis for aquaculture and processing.

Golden pompano has tender meat and delicious taste. It is rich in unsaturated fatty acids, essential amino acids and other nutrients [8].Therefore, it is popular among consumers. In 2016, the output of golden pompano in China was about 100000 tons, with rich resources and great industrial value [9]. A large number of researchers pay attention to the storage and preservation of golden pompano.

It is found that the combination of rosemary extract and nisin can effectively prolong the shelf life of refrigerated golden pompano fillets[10]. Qiu et al [11] found that chitosan coating combined with citric acid and licorice extract could effectively inhibit the lipid oxidation of golden pompano under the condition of freezing storage at -18 ℃ by measuring the peroxide value (POV), thiobarbituric acid reactive substances (TBARS) value and drip loss. At present, few researchers pay attention to the volatile flavor components of golden Pomfret.

Using headspace solid phase microextraction and simultaneous distillation extraction, combined with gas chromatography-mass spectrometry, there were 88 volatile compounds identified from the muscle of sea-cage cultured *Trachinotus ovatu*[12]. These volatile compounds were mainly aldehydes, hydrocarbons and alcohols.

Therefore, the volatile components of meat, skin and mucus of golden pompano were analyzed, identified and compared by headspace solid phase microextraction gas chromatography-mass spectrometry, in order to provide a theoretical basis for the cultivation and processing of golden pompano.

## 2. Materials and Apparatus

### 2.1. Materials

Fresh golden pompanos were obtained from the Longdong Market (Guangzhou, China). Ten golden pompanos were randomly selected and killed in the laboratory with heavy blow on the head, then washed with distilled water repeatedly. Scrape the mucus from the surface of golden pompanos with scalpel, mix it and pack it for frozen storage. Then the skin and fillets of golden pompanos were crushed by meat grinder and frozen at -18 ℃.

### 2.2. Reagents and Apparatus

The reagents used in this study included: NaCl was analytical pure. The apparatus used in this study included: GCMS-QP2010 Ultra Gas Chromatography-mass Spectrometer (Shimadzu Institute, Japan), DK-3001N Headspace Sampler (Beijing Zhongxinghuili Technology Development Co., Ltd),

BSA2202S Electronic Balance (Saiduolis Scientific Instrument (Beijing) Co., Ltd.), AMG199AM3-200 Meat Grinder (Zhongshan Ouboer Electric Appliance Co., Ltd), SPME injection handle (Supelco, USA), 50 μ m Diethylphenyl / Carbon molecular sieve / Polydimethylsiloxane extraction head (Supelco, USA), headspace extraction bottle ( Shanghai Anpu Scientific Instrument Co., Ltd).

## 3. Method

### 3.1. Steps of headspace solid phase microextraction

In this experiment, The volatile components of fillets, skin and mucus from golden pompano was analyzed by HS-SPME - GC-MS.

The steps are as follows: the frozen samples (fillets, skin or mucus from golden pompano)were thawed at room temperature and then extracted. Weigh 5 g of the samples, add 5 mL of NaCl solution (0.18 g / mL), grind evenly, take 6 g of homogenous slurry and place it in a 15 mL headspace bottle, and seal it with a gland. After equilibration at 60 ℃ for 20 min, the activated extraction head was inserted for adsorption extraction for 40 min. After adsorption, take out the extraction head and insert it into the injection port for 5 minutes.

### 3.2. GC-MS Conditions

#### 3.2.1 Gas chromatography conditions.

The GC system used chromatographic separation was achieved by using a fused capillary column Rts-5MS, length (30m×0.25mm×0.25um). The initial column temperature was 35 ℃,and it was raised to 40 ℃ at 5 ℃/min for 2 min.Then it was raised to180 ℃ at 4 ℃/min for 5 min,finally raised to250 ℃ at 10 ℃/min for 5min. The carrier gas was high purity helium with a flow rate of 0.8 mL / min. The injection temperature is 250 ℃, the desorption temperature is 250 ℃, and the desorption time is 5 min. There is no split injection.

#### 3.2.2 Mass spectrometry conditions.

Electron bombardment ion (EI) source is used as ionization mode. The monitoring method is full scanning. The scanning range is 35-450. The ionization energy is 70eV. The ion source temperature is 230℃.

### 3.3. Qualitative analysis.

Qualitative analysis was carried out by searching NIST 11 standard library, selecting compounds with a matching degree of more than 80%, and combining the results of literature reports for qualitative analysis. The relative percentage content of each compound in total volatile components was calculated by peak area normalization method.

## 4. Conclusion

### 4.1. Composition of volatile components in edible parts of golden pompano

According to table 1, 57 volatile components were identified from the fillets, skin and mucus of golden pompano, including 8 alcohols, 13 aldehydes, 2 ketones, 2 esters, 30 hydrocarbons and 2 others. 19 volatile components were identified from the fillets, including 2 alcohols, 4 aldehydes, 1 ester and 12 hydrocarbons. The relative contents of the volatile components were diethyl phthalate (49.91%), nonanal (9.86%), 1-hexanol, 2-ethyl (8.74%), 1,3,5,7-cyclooctatetraene (7.27%), octanal (4.33%) and heneicosane (4.08%). It was reported that 51 compounds were identified from the muscle of golden pompano in Hainan, including 5 alcohols, 15 aldehydes, 3 esters, 19 hydrocarbons, 1 ketone, 2 aromatics, 4 acids and 2 other compounds [8]. The amount of volatile components in golden pompano identified in the literature was higher than that in this study, which may be due to the

differences of sample origin and experimental methods. The volatile flavor components have a great relationship with the origin of raw materials, breeding methods and storage methods[13].

25 volatile components were identified from the skin, including 1 alcohol, 3 aldehydes, 1 ester and 20 hydrocarbons. The relative contents of the volatile components were diethyl phthalate (33.74%), 1,3,5,7-cyclooctatetraene (14.73%), benzene, 1,2,3-trimethyl (9.59%), 1-hexanol, 2-ethyl (9.43%), heptadecane (8.57%), nonanal (3.94%), heneicosane (2.72%) and pentadecane, 2,6,10,14-tetramethyl (2.67%).

34 kinds of volatile components were identified from the mucus, including 7 alcohols, 12 aldehydes, 2 ketones, 2 esters, 9 hydrocarbons and 2 others. The relative contents of volatile components were 1-octen-3-ol (19.32%), diethyl phthalate (14.37%), 3-cyclohexene-1-ethanol (13.27%), 2-hexene, 3,5,5-trimethyl (11.49%), 2-octen-1-ol, (e)- (9.81%), 1-hexanol, 2-ethyl (7.98%), 2,5-octanedione (4.06%), 1,3,5,7-cyclooctatetraene (2.71%) and 2-octenal (2.58%).

### 4.2. Comparative analysis of volatile components in edible parts of golden pompano

There are nine common volatile components in the fillets, skin and mucus of golden pompano, which are 1,3,5,7-cyclooctatetraene, octanal, 1-hexanol,2-ethyl, dodecane, decanal, tetradecane, diethyl phthalate, heneicosane and pentadecane,2,6,10,14-tetramethyl. among them, octanal and decanal may have great influence on the fishy smell.

## 5. Discussion

The volatile components of fillets, skin and mucus from golden pompano were analyzed by HS-SPME-GC-MS. A total of 57 volatile components were identified in the fillets, skin and mucus of fresh golden pompano, including 8 alcohols, 13 aldehydes, 2 ketones, 2 esters, 30 hydrocarbons and 2 others. The amount of alcohols, aldehydes, ketones, esters and other volatile components in mucus was more than that in fish fillets and skin. This study can provide a theoretical basis for the cultivation and processing of golden pompano. The migration pathway of fishy odor components may not exist in the aquaculture stage: from water of the aquaculture environment to mucus, fish skin to fish meat. Therefore, fully removing the mucus on the surface from fish can ensure that there is less fishy smell in fish skin and meat.

**Table 1.** Volatile compositions extracted from fillets, skin and mucus of golden pompano

| No. | Retention tR/min | Compound name | Percentage of compound in total area /% | | |
|---|---|---|---|---|---|
| | | | fillets | skin | mucus |
| 1 | 10.3 | 1,3,5,7-Cyclooctatetraene | 7.27 | 14.73 | 2.71 |
| 2 | 18.614 | Benzene, 1-ethyl-2-methyl | - | 1.49 | - |
| 3 | 18.687 | 2-Hexene, 3,5,5-trimethyl | - | - | 11.49 |
| 4 | 18.89 | 1-Octen-3-one | - | - | 1.11 |
| 5 | 19.267 | 1-Octen-3-ol | - | - | 19.32 |
| 6 | 19.567 | 2,5-Octanedione | - | - | 4.06 |
| 7 | 19.694 | Benzene, 1,2,3-trimethyl | - | 9.59 | - |
| 8 | 20.612 | Octanal | 4.33 | 1.44 | 1.45 |
| 9 | 21.015 | 2,4-Heptadienal | - | - | 0.45 |
| 10 | 21.908 | Cyclohexene, 1-methyl-4-(1-methylethenyl) | - | - | 0.40 |
| 11 | 22.166 | 1-Hexanol, 2-ethyl | 8.74 | 9.43 | 7.98 |
| 12 | 23.071 | Benzene, 1-methyl-3-propyl | - | 0.96 | - |
| 13 | 23.423 | Benzene, 1-ethyl-3,5-dimethyl | - | 1.45 | - |
| 14 | 23.599 | 2-Octenal | 0.56 | - | 2.58 |
| 15 | 24.124 | 2-Octen-1-ol, (E)- | - | - | 9.81 |
| 16 | 24.256 | 3-Cyclohexene-1-ethanol | - | - | 13.27 |

| | | | | | |
|---|---|---|---|---|---|
| 17 | 24.312 | Benzene, 2-ethyl-1,4-dimethyl | - | 1.14 | - |
| 18 | 24.377 | 1-Octanol | 1.23 | - | - |
| 19 | 24.472 | 2,4-Undecadien-1-ol | - | - | 1.24 |
| 20 | 25.116 | 4,7-Methano-1H-indene, octahydro- | - | 0.86 | - |
| 21 | 25.603 | Benzene, 1-ethyl-2,3-dimethyl | - | 1.07 | - |
| 22 | 25.732 | Undecane | 0.79 | - | - |
| 23 | 25.86 | Nonanal | 9.86 | 3.94 | - |
| 24 | 26.35 | Benzene, 1,2,3,4-tetramethyl | 0.47 | - | - |
| 25 | 27.187 | 1H-Indene, 2,3-dihydro-5-methyl | - | 0.65 | - |
| 26 | 27.904 | 2,6-Nonadienal | - | - | 1.18 |
| 27 | 28.26 | 2-Nonenal | - | - | 0.43 |
| 28 | 28.345 | Benzene, 1-methyl-4-(1-methylpropyl) | - | 0.37 | - |
| 29 | 28.791 | 1-Nonanol | - | - | 0.21 |
| 30 | 28.954 | Levomenthol | - | - | 0.13 |
| 31 | 29.095 | Azulene | 0.55 | - | - |
| 32 | 29.265 | 1H-Indene, 2,3-dihydro-1,6-dimethyl | - | 0.28 | - |
| 33 | 29.638 | 3,4-Dimethylcumene | - | 0.64 | - |
| 34 | 29.981 | Dodecane | 1.32 | 1.22 | 0.42 |
| 35 | 30.146 | Decanal | 2.76 | 0.88 | 0.45 |
| 36 | 30.495 | 2,4-Nonadienal | - | - | 0.20 |
| 37 | 32.27 | 2-Decenal | - | - | 0.15 |
| 38 | 32.802 | Dodecane, 2,6,11-trimethyl | 0.52 | - | - |
| 39 | 32.805 | Dodecane, 4,6-dimethyl | - | 0.22 | - |
| 40 | 33.595 | Formamide, N,N-dibutyl- | - | - | 0.29 |
| 41 | 33.72 | Tetradecane | 2.15 | 1.48 | 1.50 |
| 42 | 34.263 | 2,4-Decadienal | - | - | 0.66 |
| 43 | 34.47 | Nonane, 5-methyl-5-propyl | 0.45 | - | - |
| 44 | 35.051 | 1-Docosene | - | - | 0.95 |
| 45 | 36.313 | Hexadecane, 2,6,10,14-tetramethyl | 0.56 | 0.21 | - |
| 46 | 36.862 | Cetene | 0.55 | - | - |
| 47 | 39.034 | 2,5-Cyclohexadiene-1,4-dione, 2,6-bis(1,1-dimethylethyl) | - | - | 0.34 |
| 48 | 40.087 | 1-Pentadecene | - | 0.26 | - |
| 49 | 40.334 | Pentadecane, 7-methyl | - | - | 1.34 |
| 50 | 40.343 | Heptadecane | - | 8.57 | - |
| 51 | 42.875 | Diethyl Phthalate | 49.91 | 33.74 | 14.37 |
| 52 | 43.66 | Tetradecanal | - | - | 0.14 |
| 53 | 46.18 | Heneicosane | 4.08 | 2.72 | 0.20 |
| 54 | 46.291 | Pentadecane, 2,6,10,14-tetramethyl | 3.90 | 2.67 | 0.24 |
| 55 | 46.543 | Pentadecanal | - | - | 0.22 |
| 56 | 49.623 | Hexadecanal | - | - | 0.38 |
| 57 | 51.073 | 1,2-Benzenedicarboxylic acid, bis(2-methylpropyl) ester | - | - | 0.34 |

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