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Sensory, organoleptic, and proximate composition of smoked surgeon fish *Acanthurus* sp. using selected herbs as flavor enhancer

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Abstract
The study evaluated the sensory, organoleptic and proximate composition of smoked Surgeon fish *Acanthurus* sp. using the extracts of either calamansi leaves, lemon grass or guava leaves.
Effectiveness of these herbs as off-odor and off-flavor remover and flavor enhancer were evaluated in terms of color, aroma, taste, texture and general acceptability. Panelists include ten (10) members each from the group of cook, pupils, students (high school and college) and professionals (professors and researcher).
Results of the study revealed that smoked Surgeon fish treated with guava leaf extract is the most preferred and highly acceptable by the panelists. Analysis of the sensory and organoleptic evaluation also shows that smoked Surgeon fish treated with either guava leaf, lemongrass, calamansi leaf extracts is highly acceptable based on the different criteria of evaluation. Similarly, the guava leaf extract also masked the off-odor of smoked Surgeon fish.
The smoked surgeon fish treated with guava leaf extract were also subject to carcass analysis. Proximate composition revealed that smoked Surgeon contains 54.77% crude protein, 0.58% crude fiber, 11.38% crude fat, 29.55% moisture and 13.07% ash.

Keywords: smoking, *acanthuridae* sp., calamansi leaves, guava leaves, and lemon grass

1. Introduction
Surgeon fishes and unicorn fishes are most often found on or near coral reefs or rocky areas. The entire genus of the species of *Acanthurus* and many of the *Naso* are herbivorous; they eat benthic organism and seagrasses. The species of the genus *Acanthurus* feed primarily on corals. Species under the *Acanthurus* family have a thick-walled, gizzard-like stomach. *Acanthurus* species intake a huge amount of sediments rather other species because of the thin-walled stomach. Comparing to two species of *Acanthurus* like *Paracanthurus* and *Naso*, they are zooplankton feeder (FAO, 1983) [3].
The main reason for the low market value of surgeon fish is the foul and distinct muddy odor and sometimes off-flavor that this fish imparts to those who consumes it. Town folks claimed that traces of the foul odor can be smelled in the sweat and urine and this usually last for almost a week. This might be the basis why town folks called it "isanglinggongpag-ibig".
This study generally aims to improve the quality attributes of surgeon fish *Acanthurus* sp. by removing its off odor and flavor using natural aromatic flavoring.
Result of this study may be used immediately by the fisher folk community, the removal of off-odor of surgeon fish. Researchers for the academic and research institutions my use this as a baseline information in the search for natural aromatic flavoring for the improvement of the flavor, aroma, texture and general appearance of different fish processing products.

2. Materials and Methods
2.1 Experimental fish
This study used surgeon fish *Acanthurs* sp. (Figure 1.) the fish were transported from the municipalities of Palanan and Divilacan to the Provincial Institute of Fisheries Roxas, Isabela. A total of 15 kg surgeon fish was used for the whole study.

Fig 1: Surgeon fish *Acanthurus* sp.

Kingdom: Animalia
Phylum: Chordata
Class: Actinopterygii
Order: Perciformes
Family: Acanthuridae
Genus: Acanthurus

2.2 Test plant
The source of selected herbs used in this study includes; calamansi leaf (*Citrus micropora*), guava leaf (*Psidium guajava*) and lemon grass (*Cymbopogon citratus*). The stem, leaves of calamansi, guava and lemon grass were obtained at Matusalem,Roxas, Isabela and Kalabaza, Aurora, Isabela.

Fig 2: Clamansi leaf, guava leaf and lemon grass used

2.3 Experimental treatments
The stem and leaves of calamansi, guava and lemon grass serves as experimental treatment with 15% brine solution served as the control group. Each treatment and control group used ten (10) fish. The assignment of experimental treatment is shown in table 1.

Table 1: The different concentration of each treatment used.

Treatment Description
T1 7% brine solution
T2 7% brine with calamansi leaves
T3 7% brine with guava leaves
T4 7% brine with lemon grass

2.4 Preparation of experimental fish
The experimental fish *Acanthurus*sp. were prepared by cleaning ad washing it with fresh top water. The weight of the fish for treatment is determined and recorded. Each fish was prepared in split form.

2.5 Preparation of plant extracts
Each plant extracts were prepared separately. The stem of lemon grass was finely chopped using knife and chopping board. The leaf of calamansi and guava were prepared by cutting each leaf into small pieces using scissors and chopping it afterwards in the chopping board.

The weight of each chopped plant material was pre-determined. The natural aromatic flavoring of each plant were determined by preparing an equal proportion of plant material to ratio (1 kg plant material:1L of water). The plant material and water mixture are boiled for 30 minutes the solid (steam and leaves) materials were separated from the liquid using cheese cloth. The filtered solution as stored in the refrigerator until used.

2.6 Experimental procedure
The fish were first soaked in the experimental treatments solution for 15 minutes. Then, the fish were steam for 3-5 minutes in the experimental solution. After steaming, the fish were dried under the sun for 2-3 hours or until the pellicle formed has already dried up.

The dried surgeon fish were placed in the modified smoked house (drum type) and were smoked using rice hull for 3-5 hours or until the desired color had been achieve.

2.7 Procedure for the taste test
The taste test immediately followed after smoking the smoked surgeon fish were deep-fried in cooking oil for 15 minutes. There were a total of 40 panelists for the taste test, categorize into students (high school and college), elementary pupils, professionals (professors and researchers) and cook (commercial cook). There were ten (10) persons for category of panels.

The panelist was asked to rate the color, aroma, taste, texture and the general acceptability of smoked surgeon fish treated with natural aromatic flavoring using five (5) points Likered rating scale where: 1-unacceptable; 2- slightly acceptable; 3-acceptable; 4-moderately acceptable; 5-highly acceptable. The panelist was asking to taste and immediately rate the product per treatment. They were given with water immediately after tasting product from each treatment to remove the aftertaste of the product. The schematic diagram of the procedures followed from the preparation of smoked surgeon fish up to taste test.

2.8 Proximate analysis of smoked surgeon fish
Samples of smoked surgeon fish were sent to Department of Agriculture-RFO 02, Integrated Laboratory Division, Cagayan Valley Integrated Agricultural Laboratory, Regional Government Center, Carig Sur, Tuguegarao City, for the proximate analysis of the crude protein,crude fiber, crude fat, moisture and ash in percent using the standard method of analysing.

2.9 Statistical analysis
Response/rating for each panelist were grouped and tabulated. Treatment means per category of panelist and criteria for evaluation were determined and was analyzed using one-way analysis of variance (ANOVA) using the general linear model). Treatment means were comparing using the Tukey's test of the SPSS Program for conducts, version 21. Descriptive rating was incorporated in each the treatments mean per category of panelist and criteria of evaluation.

3. Results
The results of the sensory and organoleptic evaluation of selected herbs as flavor enhancer for smoked Surgeon fish is presented in the following sections: a). preference of the panelists, b). acceptability of the herbs as flavor enhancer, c). acceptability of treated smoked Surgeon fish based on criteria of evaluation, d). overall acceptability of herbs as flavor enhancer, e). proximate composition of smoked Surgeon fish.

3.1 Preference of the panelists
The result of sensory and organoleptic evaluation of each panelist on the color, aroma, taste and texture of smoked Surgeon fish treated with herbs as flavor enhancer is shown in Tables 2 to 5.

Table 2: Sensory and organoleptic evaluation (mean ± SD) of students (n=10) on the color, aroma, taste, and texture of smoked Surgeon fish *Acanthurus* sp. using selected herbs as flavor enhancer.

Evaluation Criteria						
Treatment	**Color**	**Aroma**	**Taste**	**Texture**	**General Acceptability**	**Descriptive Rating**
Brine Solution	4.00±0.94	3.90±0.57	4.50±0.71	3.80±0.92	4.05	HA
Calamansi Leaves	3.50±1.08	4.10±0.74	4.10±0.99	3.60±0.97	3.83	MA
Guava Leaves	4.60±0.52	4.10±1.10	4.20±1.0*	4.20±0.9*	4.28	HA
Lemon Grass	3.90±0.87	3.60±0.84	3.50±1.08	3.80±0.63	3.70	MA
Mean	4.00	3.90	4.07	3.85		

Legend*: **U**= Unacceptable, **SU**= Slightly unacceptable, **A**=Acceptable, **MA**= Moderately Acceptable, **HA**=Highly Acceptable*
** = significant at p<0.05*

3.1.1 Student panelist

Smoked Surgeon fish treated with guava leaf is the most preferred and generally accepted by student panelists. It has a rating of 4.28 (HA), followed by the control (brine solution), calamansi leaves, and lemon grass with 4.05 (HA), 3.83 (MA), and 3.7 (MA) respectively. All the treatments means are not statistically different from each other. However, the texture of smoked Surgeon fish treated with guava leaf extrasct is significantly different among other treatments. Smoked Surgeon fish treated with guava leaves also obtained the highest preference in terms of color and texture. On the other hand, control (brine solution) obtained the highest taste preference while calamansi leaf and guava leaf treated smoked Surgeon fish obtained the most preferred aroma.

Table 3: Sensory and organoleptic evaluation (mean ± SD) of pupils (n=10) on the color, aroma, taste, and texture of smoked Surgeon fish *Acanthurus* sp. using selected herbs as flavor enhancer.

Evaluation Criteria						
Treatment	**Color**	**Aroma**	**Taste**	**Texture**	**General Acceptability**	**Descriptive Rating**
Brine Solution	3.30±1.16	3.30±1.16	3.30±1.16	3.30±1.16	3.30	MA
Calamansi Leaves	3.70±0.95	3.70±0.95	3.70±0.95	3.70±0.95	3.70	MA
Guava Leaves	3.40±1.35	3.40±1.35	3.40±1.35	3.40±1.35	3.40	MA
Lemon Grass	3.60±1.14	3.60±1.16	3.60±1.14	3.60±1.35	3.60	MA
Mean	3.5	3.5	3.5	3.5		

Legend*: **U**= Unacceptable, **SU**= Slightly unacceptable, **A**=Acceptable, **MA**= Moderately Acceptable, **HA**=Highly Acceptable*

3.1.2 Pupil panelists

Smoked Surgeon fish treated with calamansi leaves is the most preferred and generally accepted by pupil panelists. It has a rating of 3.7 (MA), followed by the lemon grass, guava leaves, and brine solution with 3.60 (MA), 3.40 (MA), and 3.30 (MA) respectively. However, all the treatments means are not statistically different from each other. Smoked Surgeon fish treated with calamansi leaves also obtained the highest preference in terms of color, aroma, taste and texture.

Table 4: Sensory and organoleptic evaluation (mean ± SD) of professionals (n=10) on the color, aroma, taste, and texture of smoked Surgeon fish *Acanthurus* sp. using selected herbs as flavor enhancer.

Evaluation Criteria						
Treatment	**Color**	**Aroma**	**Taste**	**Texture**	**General Acceptability**	**Descriptive Rating**
Brine Solution	3.40±0.84	3.40±0.84	3.40±0.97	3.30±0.85	3.38	MA
CalamansiLeaves	3.40±0.82	3.60±0.99	3.40±0.82	3.50±0.99	3.48	MA
Guava Leaves	4.30±0.92	4.00±0.95	4.60±0.97	4.50±0.97	4.35	HA
Lemon Grass	4.10±0.97	3.70±0.99	3.70±1.20	3.90±1.06	3.85	MA
Mean	3.80	3.67	3.77	3.80		

Legend*: **U**= Unacceptable, **SU**= Slightly unacceptable, **A**=Acceptable, **MA**= Moderately Acceptable, **HA**=Highly Acceptable*

3.1.3 Professional panelists

Smoked Surgeon fish treated with guava leaves is the most preferred and generally accepted by professional panelists. It has a rating of 4.35 (HA), followed by the lemon grass, calamansi leaves and brine solution with 3.85 (MA), 3.48 (MA), and 3.38 (MA) respectively. However, all the treatments means are not statistically different from each other. Smoked Surgeon fish treated with guava leaves also obtained the highest preference in terms of color, aroma, taste and texture.

Table 5: Sensory and organoleptic evaluation (mean ± SD) of cooks (n=10) on the color, aroma, taste, and texture of smoked Surgeon fish *Acanthurus* sp. using selected herbs as flavor enhancer.

Evaluation Criteria						
Treatment	**Color**	**Aroma**	**Taste**	**Texture**	**General Acceptability**	**Descriptive Rating**
Brine Solution	4.10±0.88	4.10±0.88	4.10±0.88	4.00±0.82	4.08	HA
CalamansiLeaves	3.90±1.10	3.80±1.14	3.90±1.10	3.30±1.16	3.78	MA
Guava Leaves	4.60±0.52	4.60±0.70	4.50±0.97	4.10±1.29	4.45	HA
Lemon Grass	4.10±1.25	3.90±1.05	3.90±1.37	4.10±1.15	4.03	HA
Mean	3.80	3.67	3.77	3.80		

Legend*: **U**= Unacceptable, **SU**= Slightly unacceptable, **A**=Acceptable, **MA**= Moderately Acceptable, **HA**=Highly Acceptable*

3.1.4 Cook panelists

Smoked Surgeon fish treated with guava leaves is the most preferred and generally accepted by cook panelists. It has a rating of 4.45 (HA), followed by the control (brine solution), lemon grass, and calamansi leaves with 4.08 (HA), 4.03 (HA), and 3.78 (MA) respectively. However, all the treatments means are not statistically different from each other. Smoked Surgeon fish treated with guava leaves also obtained the highest preference in terms of color, aroma, and taste. On the other hand, lemon grass and guava leaves obtained the highest texture performance.

3.2 Acceptability of herbs as flavor enhancer

The result of sensory and organoleptic evaluation of each treatment on the color, aroma, taste and texture of smoked Surgeon fish using selected herbs as flavor enhancer is shown in Tables 5 to 8.

Table 6: Sensory and organoleptic evaluations of smoked Surgeon fish treated with calamansi leaves as flavor enhancer.

Panelist	Evaluation Criteria					
	Color	Aroma	Taste	Texture	General Acceptability	Descriptive Rating
Student	3.50±0.97	4.10±1.08	4.10±0.74	3.60±0.99	3.80	MA
Pupil	3.70±0.95	3.70±0.95	3.70±0.95	3.70±0.95	3.70	MA
Professionals	3.40±0.99	3.60±0.82	3.40±0.99	3.50±0.82	3.48	MA
Cook	3.90±1.16	3.80±1.10	3.90±1.14	3.30±1.10	3.73	MA
Mean	3.62	3.80	3.77	3.52		

Legend*: **U**= Unacceptable, **SU**= Slightly unacceptable, **A**=Acceptable, **MA**= Moderately Acceptable, **HA**=Highly Acceptable*

3.2.1 Calamansi leaves

Smoked Surgeon fish *Acanthurus* sp. treated with calamansi leaves is the most preferred and generally accepted by the student panelists. It has a rating of 3.83 (MA), followed by cook, pupils and professional with 3.73 (MA), 3.7 (MA) and 3.48 (MA) respectively. However, all the means are not statistically different from each other. Student panelist also obtained the highest preference in terms of aroma, and taste. On the other hand, cook obtained the highest color preference while pupils obtained the most preferred texture.

Table 7: Sensory and organoleptic evaluation of smoked Surgeon fish treated with guava leaves as flavor enhancer.

Panelist	Evaluation Criteria					
	Color	Aroma	Taste	Texture	General Acceptability	Descriptive Rating
Student	4.60±.52	4.10±1.10	4.20±1.03	4.20±0.92	4.28	HA
Pupil	3.40±1.35	3.40±1.35	3.40±1.35	3.40±1.35	3.4	MA
Professionals	4.30±0.92	4.00±0.95	4.60±0.97	4.50±0.97	4.35	HA
Cook	4.60±0.52	4.60±0.70	4.50±0.97	4.10±1.29	4.45	HA
Mean	4.22	4.02	4.17	4.05		

Legend*: **U**= Unacceptable, **SU**= Slightly unacceptable, **A**=Acceptable, **MA**= Moderately Acceptable, **HA**=Highly Acceptable*

3.2.2 Guava leaves

Smoked Surgeon fish *Acanthurus* sp. treated with guava leaves is the most preferred and generally accepted by the cook panelists. It has a rating of 4.45 (HA), followed by professional, student and pupils with 4.35 (HA), 4.28 (HA) and 3.4 (MA) respectively. However, all the panelist means are not statistically different from each other. Cook panelist also obtained the highest preference in terms of color, and aroma. On the other hand, professional obtained the highest taste and texture preference.

Table 8: Sensory and organoleptic evaluation of smoked Surgeon fish treated with lemon grass as flavor enhancer.

Evaluation Criteria						
Panelist	Color	Aroma	Taste	Texture	General Acceptability	Descriptive Rating
Student	3.90±0.88	3.60±0.84	3.50±1.08	3.80±0.63	3.70	MA
Pupil	3.50±1.14	4.10±1.14	4.10±1.54	3.60±1.14	3.80	MA
Professionals	4.60±0.97	4.10±0.99	4.20±1.19	4.20±1.06	4.28	HA
Cook	3.90±1.25	3.60±1.05	3.50±1.37	3.80±1.15	3.70	MA
Mean	3.97	3.85	3.82	3.70		

Legend*: **U**= Unacceptable, **SU**= Slightly unacceptable, **A**=Acceptable, **MA**= Moderately Acceptable, **HA**=Highly Acceptable*

3.2.3 Lemon grass

Smoked surgeon fish *Acanthurus* sp. treated with lemon grass is the most preferred and generally accepted by the cook panelists. It has a rating of 4.03 (HA), followed by professional, student and pupils with 3.85 (MA), 3.7 (MA) and 3.6 (MA) respectively. However, all the panelist means are not statistically different from each other. Cook panelist also obtained the highest preference in terms of aroma, taste and texture. On the other hand, professional obtained the highest color preference.

Table 9: Sensory and organoleptic evaluation of smoked Surgeon fish without using herbs as flavor enhancer

Evaluation Criteria						
Panelist	**Color**	**Aroma**	**Taste**	**Texture**	**General Acceptability**	**Descriptive Rating**
Student	4.00±0.9	3.90±0.57	4.50±0.71	3.80±0.92	4.05	HA
Pupil	3.30±1.1	3.30±1.16	3.30±1.16	3.30±1.16	3.30	MA
Professionals	3.40±0.8	3.40±0.84	3.40±0.84	3.30±1.16	3.38	MA
Cook	4.10±0.8*	4.10±0.88	4.10±0.88	4.00±0.82	4.08	HA
Mean	3.70	3.36	3.82	3.60		

Legend: U= Unacceptable, SU= Slightly unacceptable, A=Acceptable, MA= Moderately Acceptable, HA=Highly Acceptable
** = significant at p<0.05*

3.2.4 Brine solution

Smoked Surgeon fish *Acanthurus* sp. without using any aromatic flavoring is the most preferred and generally accepted by the cook panelist. It has a rating of 4.08 (HA), followed by student, Professional and pupils with 4.05 (HA), 3.38 (MA) and 3.3 (MA) respectively. All the panelist means are not statistically different from each other. However, the color of smoked Surgeon fish without herbs as flavor enhancer is significantly different among the other treatments. Cook panelist also obtained the highest preference in terms of color, aroma and texture. On the other hand, student obtained the highest taste preference.

3.3 Acceptability of treated smoked Surgeon fish base on criteria of evaluation

The acceptability of smoked Surgeon fish treated with herbs as flavor enhancer based on color, aroma, taste, and texture is shown in Tables 10 to 13**.**

Table 10: Evaluation of the color of smoked Surgeon fish treated with herbs as flavor enhancer.

	Control/Brine solution	**Calamansi leaf extract**	**Guava leaf extract**	**Lemon grass extract**	**Mean**
Student	4.00±0.94	4.10±0.88	4.60±0.97	3.90±1.25	4.15
Pupils	3.30±1.16	3.70±0.95	3.40±0.84	3.50±1.08	3.47
Professionals	3.40±0.84	3.60±0.97	4.30±0.92	4.60±0.97	3.97
Cook	4.10±0.88	3.80±0.63	4.60±0.97	3.90±1.25	4.10
Mean	3.70	3.80	4.22	3.97	

3.3.1 Color

Among the treatment and the control groups, the most preferred and moderately acceptable by different panelists in terms of color preference is the fish treated with guava leaves. This is follow by fish treated with lemon grass extract, which is acceptable by the panelists.

Table 11: Evaluation of the aroma of smoked Surgeon fish treated with herbs as flavor enhancer.

	Control/Brine solution	Calamansi leaf extract	Guava leaf extract	Lemon grass extract	Mean
Student	3.90±1.25	4.10±0.88	4.10±0.88	3.60±0.97	3.92
Pupils	3.30±1.16	3.70±0.95	3.40±0.84	4.10±0.88	3.62
Professionals	3.40±0.84	3.60±0.97	4.00±0.94	4.10±0.88	3.77
Cook	4.10±0.88	3.80±0.63	4.60±0.97	3.60±0.97	4.02
Mean	3.67	3.80	4.02	3.85	

3.3.2 Aroma

Among the treatment and the control groups, the most preferred and moderately acceptable by different panelists in terms of aroma preference is the fish treated with guava leaves. This is follow by fish treated with lemon grass extract, which is acceptable by the panelists.

Table 12: Evaluation of the taste of smoked Surgeon fish treated with herbs as flavor enhancer.

	Control/Brine solution	**Calamansi leaf extract**	**Guava leaf extract**	**Lemon grass extract**	**Mean**
Student	4.00±0.94	4.10±0.88	4.20±1.03	3.50±1.08	3.95
Pupils	3.30±1.16	3.70±0.95	3.40±0.84	4.10±0.88	3.62
Professionals	3.40±0.84	3.40±0.84	4.50±1.08	4.20±1.03	3.87
Cook	3.10±0.88	3.90±1.25	4.10±0.88	3.50±1.08	3.65
Mean	3.45	3.77	4.05	3.82	

3.3.3 Taste

Among the treatment and the control groups, the most preferred and moderately acceptable by different panelists in terms of taste preference is the fish treated with guava leaves. This is follow by fish treated with lemon grass extract, which is acceptable by the panelists

Table 13. Evaluation of the texture of smoked Surgeon fish treated with herbs as flavor enhancer.

	Control/Brine solution	**Calamansi leaf extract**	**Guava leaf extract**	**Lemon grass extract**	**Mean**
Student	3.80±0.63	3.60±0.97	4.20±1.03	3.80±0.63	3.85
Pupils	3.30±1.16	3.70±0.95	3.40±0.84	3.60±0.97	3.50

Professionals	3.30±1.16	3.50±1.08	4.5±0.97	4.20±1.03	3.89
Cook	4.00±0.94	3.30±1.16	4.10±0.88	3.70±0.95	3.79
Mean	3.64	3.52	4.05	3.82	

3.3.4 Texture

Among the treatment and the control groups, the most preferred and moderately acceptable by different panelists in terms of texture preference is the fish treated with guava leaves. This is follow by fish treated with lemon grass extract, which is acceptable by the panelists

3.4 General Acceptability of herbs as flavor enhancer for smoked Surgeon fish

The general acceptability of herbs as flavor enhancer for smoked Surgeon fish is shown in Table 14.

Table 14: General Acceptability of the plant extracts as flavor enhancer for smoked Surgeon fish according to the respondents.

	Control/Brine	Calamansi leaf extract	Guava leaf extract	Lemon grass extract	Mean
Student	4.05±0.94	3.83±0.63	4.28±1.03	3.70±0.95	3.96
Pupils	3.30±1.16	3.70±0.95	3.40±0.84	3.80±0.63	3.55
Cook	3.30±1.16	3.48±0.84	4.35±0.92	3.70±0.95	3.72
Professionals	4.08±0.94	3.73±0.95	4.45±0.95	4.28±1.03	4.13
Mean	3.70	3.68	4.12	3.87	

Smoked Surgeon fish treated with guava leaf extract is the most preferred and moderately acceptable based on the general acceptability analysis. This is followed by lemon grass extract, calamansi leaf extract which are all acceptable. Even though the general acceptability of the smoked Surgeon fish treated with herbs as flavor enhancer is about the control (brine solution), it is not significantly different to each other.

3.5 Proximate composition of smoked Surgeon fish

The smoked Surgeon fish treated with guava leaf extract were subjected to carcass analysis, the result is presented in Table 15.

Table 15

Sample	Crude Protein (%)	Crude Fiber (%)	Crude Fat (%)	Moisture (%)	Ash (%)
Smoked Surgeon fish treated with Guava leaf extract	54.77	0.58	11.83	29.55	13.07

The smoked Surgeon fish treated with guava leaf extract were subjected to carcass analysis. Proximate composition revealed that smoked Surgeon fish contains 54.77% crude protein, 0.58% crude fiber, 11.38% crude fat, 29.55% moisture and 13.07% ash.

4. Discussions

The study was conducted to mask the off-odor and off-flavor of smoked Surgeon fish using calamansi leaves, lemon grass, and guava leaves. Effectiveness of the herbs as off-odor and off-flavor and flavor enhancer was evaluated in terms of color, aroma, taste, texture and general acceptability.

Among the different treatments, the color of smoked Surgeon fish treated with guava leaf extract is the most preferred and highly accepted by the panelists. Color has a drastic effect on the perception of flavor, due to the information that received from eyes will lead us to anticipate a flavor based on the color of a food, and that initial assumption can override the information we receive from our taste buds and olfactory system. Guava leaf extract imparted a darker coloration, which is suited for smoked product, like this recent study.

Majority of the panelists preferred the odor of smoked Surgeon fish treated with guava leaf extract as compared to other treatments. Guava leaves impart The leaves contain essential oil with the main components being α-pinene, β-pinene, limonene, menthol, terpenyl acetate, isopropyl alcohol, longicyclene, caryophyllene, β-bisabolene, caryophyllene oxide, β-copanene, farnesense, humulene, selinene, cardinene and curcumene (Zakaria *et al.*, 1994) [11]. The essential oil from the leaves has been shown to contain, nerolidiol, β-sitosterol, ursolic, crategolic, and guayavolic acids have also been identified (Iwu, 1993) [7]. The cognitive processing of odor signals has a large impact on odor perception. Odor perception seems to be particularly linked with memories from long ago, more so than other types of sensory perception (Lawless and Heyman, 1998) [9].

The reasons for this are not understood, but it seems clear that training of odor recognition is no replacement for experience with odors. Lesschaeve and Issanchou (1996) [10] found that odor memory is more related to previous experience of a subject with an odor than with training a subject to recognize an odor. Odorants are small molecules, usually less than 1 kDa. They are light enough to be breathed into the nose but heavy enough to be recognized by receptors. Almost all aromas are a result of various such odorants, usually several hundred. Even though a few substances in an aroma may be the key contributors it is still comprised of all the odorants. The human brain is able to recognize a large number of odorants, possibly up to 10.000. Millions of olfactory receptors are at work when a food is smelled and they send messages to the brain, which then processes them and delivers identification of the aroma. It is not yet known whether each odorant has its own receptor, but it is considered likely in light of the fact that these receptors are very many, likely 1.00010.000. Before reaching the receptor, an odorant must travel through the olfactory mucus, covering the olfactory epithelium. The odorant might take part in many reactions before binding to the receptor cell (Bell, 1996) [1].

Aroma can also appear as flavor, although not necessarily in tandem. Since most of what people perceive as "taste"

actually results from their sense of smell. The human of tongue can only detect four basic taste sensations. Sweet, sour, bitter and salty, plus a fifth sensation called "umami" all other taste is a result of the sense of smell. When people eat and drink, they are about to taste. This is an innate process that has been taking place since the beginning of human existence, smelling food to determine if it was safe to eat.

In the present study, the taste of smoked Surgeon fish treated with guava leaf extract is the most preferred and highly accepted by the panelists.

The relative intensity of individual chemical odorants and flavoring is a subject that the daily confronts those involved in the creation of fragrances and flavors. The actual measurement of such intensities has been largely restricted to the determination of the threshold values of "detection". This is the value determined by respondents at which the odor or flavor of a "pure" odorant can be detected. This might be due to some dependent number of factors: (a) experimental methodology, (b) screening of panelist for specific anosmia, (c) experience of panelist, (d) purity of odor/flavor chemical, and Ç= sex and age makeup of panel and (f) the media in which the odorant is evaluated (Guillén, and Manzanos, 2002) [5].

Individual differences in flavor perception are regarded as noise by some researchers, but are actually very real and can tell us many things about people as instruments. They can be genetical, for example inherited color-blindness, ability to taste phenylthiocarbamide, etc. They can be physiological, for example saliva production and perhaps differences in brain neurology. Differences because of personality can perhaps be divided in two groups, first perceptual differences connected to personality traits, such as very efficient and accurate people being better able to discriminate between samples; second response differences, or how the personality of a person can affect their responses to perception, that is shyness of using the scales, or willingness to please, thus giving higher responses.

Taste involves substances binding to receptors on the tongue and in the back of the throat. A food cannot be tasted without being put in the mouth cavity. Five or more pathways are involved in taste perception. Sugars and sweetening agents bind to special receptor proteins activating two pathways, bitter substances bind to proteins and activate one pathway and salts and acids change the electrical status of receptor cells through ion channels in the cell membrane. Receptor proteins, which umami substances bind to and the following pathways are less known (Laing and Jinks, 1996) [8].

Flavor is generally thought to consist of the volatile components sensed in the nose, both through the nostrils (orthonasally) and from inside the mouth (retronasally), nonvolatile compounds sensed on the tongue, and compounds that are perceived in the mouth as texture or mouth feel. Aroma is considered more important than taste in determining flavor. Flavor analysis has typically focused on measuring volatile compounds, for example by gas chromatography-mass spectroscopy (GCMS) and GC-olfactory methods.

De Graaf *et al.* (1996) [2] found that age affects flavor perception. A group of elderly people needed a higher concentration of some foodstuffs to report the same flavor intensity as a group of young people and the elderly also had a higher concentration for optimal preferred perceived intensity, which is the concentration where they liked the flavor best.

Flavor is usually more important in determining consumer acceptance of foods than appearance or texture. Generally sweet and salty tastes seem to increase liking and sour and bitter taste decrease it. Age usually raises preferred concentrations of sweet and salty tastes. Odor is not as clear, but it seems that exposure to odors modifies liking and age raises preferred concentrations. Trigeminal stimulation is generally unpleasant, but seems to grow more desirable with increased exposure, as is well known with chili pepper. The majority of food preferences seem to develop in the first few years of life, when children are exposed to the food practices of their family and culture. In the modern world, preferences change more during adulthood than in traditional (Högnadóttir, 2000) [6].

Studies have shown that elderly people prefer foods with stronger flavor, while young subjects preferred lower flavored versions of the same foods. Odor perception is known to diminish with age and it is theorized that by adding flavorants and/or odorants to foods, elderly people will eat more of them because of higher preference, diminishing the likelihood of malnutrition (Griep *et al*., 1997) [4].

Flavor perception is of course strongly related to odor perception, since odors are a large part of flavors. Flavor perception also changes with age and not only is perceived intensity lowered but optimal intensity is raised (De Graaf *et al.*, 1996) [2].

5. Conclusions

Smoked Surgeon fish treated with either guava leaf extract, lemon grass extract and calamansi leaf extract is highly acceptable based on the color, aroma, taste and texture. Among the treatments, smoked Surgeon fish immersed in guava leaf extract is the most preferred by the panelist.

The herbal extract that masked the off-odor of smoked Surgeon fish is the guava leaf extract based on the aroma criteria of evaluation determined by the panelists.

Proximate composition of smoked Surgeon fish treated with guava leaf extract revealed that smoked Surgeon contains 54.77% crude protein, 0.58% crude fiber, 11.38% crude fat, 29.55% moisture and 13.07% ash.

6. References

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