# RESEARCH REGARDING INFLUENCES OF DIFFERENT SMOKING TECHNIQUES ON THE SENSORIAL FEATURES OF CATFISH MEAT *(SILURUS GLANIS)*

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**Abstract**

*Fish meat represents an important foodstuff in human nutrition, due to its high nutritive value and particular sensorial qualities. Sensorial qualities of fish meat could suffer modifications as a result of higher capitalization. The current study aimed to emphasize the sensorial features differences at smoked catfish meat (Silurus glanis L., 1758) differences resulted from the utilisation of different smoking methods, with different type of woods. The utilised smoking methods were warm smoking and cold smoking, and the utilised woods were beech sawdust and sour-cherry sawdust. The applied technique, for both smoking methods, consisted in traditional smoking. Criteria utilised for sensorial evaluation were: general aspect, taste, smell, consistency and colour. Evaluation was realised by a team of six members, persons which are familiarized with fish products. The working instrument for sensorial evaluation was a scale with simple score. There were observed significant differences regarding samples colour, differences due to exposure to fume and due the utilised type of wood. In according with the obtained results, the samples processed by cold smoking proved to be superior from sensorial evaluation point of view.*

**Key words**: catfish, warm smoking, cold smoking, sensorial evaluation

## INTRODUCTION

European catfish *(Silurus glanis)* belongs to the order Siluriformes, the main representative of the Siluridae family on the European continent. Is an easily adaptable fish to environmental conditions, and can be found mainly in freshwater in Central and South-West Asia, but occasionally can be found in the salty waters of the Black Sea and Baltic Sea [6]. In our country, is widespread in large rivers in the hilly area and up to Danube mouths, but is constantly living in deep still waters [2, 3].

In our country, catfish is usually commercialized as fresh fish, but in many European countries is subject to several processes of superior capitalization, fact which increases the term of validity and sensory properties while enhancing its meat.

One of the possibilities for superior capitalization of catfish meat is represented by preservation throughout smoking [7].Smoking is by definition the technological operation which consists mainly in exposure of an aliment to aerosol smoke action in order to ensure preservation, flavouring and obtaining specific colour [4].

Depending on the fish size and meat chemical properties can be used several smoking methods, which are reflected in the quality of the finished product.

This study aims to highlight the sensory characteristics that catfish meat acquires while subjected to methods of warm and cold smoking with beech and sour cherry wood and sawdust.

## MATERIAL AND METHOD

In order to achieve this research were used 4 males (P1, P2, P3, P4) from *Silurus glanis* breed, with an approximate weight of 1.2 kg/per unit, of the age of 2 summers [5]. Fish were reared in a fish farm in Iasi County. Fish were subjected to primary processing, which consists in gutting and beheading, and the obtained carcasses were sectioned longitudinally, resulting eight half carcasses. Carcasses and torso as well as the

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eight half carcasses were weighed and classified. Sample preparation for the smoking process was done respecting modern methods from the literature [4]. Thus, after having been previously immersed in brine with a concentration of 22% NaCl, respecting a ratio fish:brine of 1:1, for 48 hours, half carcasses were washed and hung using hooks and left to drain.

Warm smoking was used at four from the eight half carcasses (P3.1, P3.2, P4.1, P4.2) using beech and sour cherry sawdust. Samples intended for warm smoking process were aired at a temperature of 60ºC, for 30 minutes, after which have undergone the process of ripening, at a temperature of 110ºC, for 35 minutes. Smoking itself was performed for 60 minutes at a temperature of 90-100ºC, samples P3.1, and P3.2 being exposed to beech smoke, and P4.1 and P4.2 samples to sour cherry smoke.

Cold smoking was applied to samples P1.1, P1.2, P2.1, P2.2. Technological flux consisted in airing for 12 hours at a temperature of 20-22ºC and smoking for 48 hours at 30-32ºC. Samples P2.1 and P2.2 are exposed to beech smoke, and samples P1.1, P1.2 to sour cherry smoke. Smoking of the half carcasses was performed using the traditional method [9].The evaluation was conducted by a team of six members, persons who are familiar with fish products. Sensory analysis was performed in a tasting room, complying with the technical requirements necessary to perform this operation. Respecting a modern working method [1] each of the board members received four coded samples, corresponding for each smoking method used. After the manner of presentation of the samples, they are classified as fractionated products, of rectangular shape, with the weight of about 20g/per sample. Sensory appreciation of the samples was performed using the analytical method of assessing the quality by scoring, using a 9-point system scale for meat [1]. According to the system scale used for each sensory characteristic is given a score between 9 and 1, where 9 indicates optimal parameters for the analysed sensory attribute according to the standard product, and following into a downtrend, obtaining a minimum score, of 1, indicating absolutely unacceptable parameters for each type of analysed sensation.

The criteria used for sensory evaluation were overall appearance, taste, smell, consistency and colour. Based on the results of sensory evaluation, total average score was calculated (Pmt) for each of the four types of samples. The obtained results are interpreted based on the scoring scale for quality evaluation [1].

The software used for statistical analysis was SPSS. We calculated the average, standard deviation, coefficient of variation and statistical significance of differences between samples, using Anova Single Factor.

## RESULTS AND DISCUSSIONS

Analysing the data from table 1 we find that the most appreciated sensory characteristic of the sample obtained by cold smoking with sour cherry sawdust is the smell, average score being of 8.83 points, and at the opposite pole hovering taste with 8.00 points.

Table 1 Sensory evaluation of catfish meat *(Silurus glanis)* cold smoked with sour cherry sawdust (P1)

| Sample cod | Number of given points (Pi) | | | | |
|---|---|---|---|---|---|
| | General aspect | Colour | Consistency | Smell | Taste |
| P900 | 9 | 8 | 8 | 9 | 8 |
| N901 | 9 | 9 | 8 | 9 | 8 |
| H902 | 9 | 9 | 9 | 9 | 8 |
| G903 | 8 | 8 | 9 | 9 | 8 |
| S904 | 9 | 9 | 8 | 8 | 8 |
| D905 | 8 | 8 | 8 | 9 | 8 |
| Average score (Pm) | 8.66 | 8.50 | 8.33 | 8.83 | 8.00 |
| Average weighted score (Pmp) | 1.92 | 1.88 | 3.69 | 5.88 | 5.32 |
| Total average weighted score (Pmt) | 18.6 | | | | |

Table 2 Sensory evaluation of catfish meat *(Silurus glanis)* cold smoked with beech sawdust (P2)

| Sample cod | Number of given points (Pi) | | | | |
|---|---|---|---|---|---|
| | General aspect | Colour | Consistency | Smell | Taste |
| P800 | 9 | 9 | 9 | 8 | 9 |
| N801 | 9 | 8 | 8 | 9 | 8 |
| H802 | 8 | 8 | 8 | 9 | 8 |
| G803 | 9 | 9 | 8 | 8 | 9 |
| S804 | 9 | 9 | 9 | 8 | 9 |
| D805 | 9 | 9 | 9 | 9 | 9 |
| Average score (Pm) | 8.83 | 8.66 | 8.50 | 8.50 | 8.66 |
| Average weighted score (Pmp) | 1.96 | 1.92 | 3.77 | 5.66 | 5.76 |
| Total average weighted score (Pmt) | 19.00 | | | | |

Values presented in table 2 shows us the fact that the cold smoked sample with beech wood was highly appreciated in terms of sensory characteristics, fact reflected in the homogeneity of average scores. Therefore, the overall indicator of product quality (Pmt), gathered 19 points, fact that makes this sample to be the most appreciated in terms of quality. Literature recommends and recognizes beech wood as one of the best essences used in meat smoking [7, 9].

Table 3 Sensory evaluation of catfish meat *(Silurus glanis)* warm smoked with beech sawdust (P3)

| Sample cod | Number of given points (Pi) | | | | |
|---|---|---|---|---|---|
| | General aspect | Colour | Consistency | Smell | Taste |
| P700 | 8 | 7 | 7 | 8 | 9 |
| N701 | 8 | 8 | 8 | 9 | 9 |
| H702 | 9 | 7 | 8 | 9 | 9 |
| G703 | 8 | 7 | 7 | 9 | 8 |
| S704 | 9 | 7 | 8 | 9 | 9 |
| D705 | 9 | 8 | 8 | 8 | 8 |
| Average score (Pm) | 8.50 | 7.33 | 7.66 | 8.66 | 8.66 |
| Average weighted score (Pmp) | 1.88 | 1.62 | 3.40 | 5.76 | 5.76 |
| Total average weighted score (Pmt) | 18.4 | | | | |

Based on the data presented in table 3 we notice, although the sensory characteristics with the highest significance factor (smell and taste) in assessing the product quality [1], were the most appreciated (8.66), fact that the colour (7.33) as well as consistency (7.66) have accumulated a lower score, made this sample to obtain the lowest weighted average total score (18.4), in comparison with the rest of the samples. However, the panel used for the qualitative assessment, used in the current study [1], fits the smoked catfish meat with beech in the “very good” product category”.

Table 4 Sensory evaluation of catfish meat *(Silurus glanis)* warm smoked with sour cherry sawdust (P4)

| Sample cod | Number of given points (Pi) | | | | |
|---|---|---|---|---|---|
| | General aspect | Colour | Consistency | Smell | Taste |
| P600 | 8 | 8 | 8 | 9 | 8 |
| N601 | 7 (x) | 8 | 7 (x) | 8 | 8 |
| H602 | 9 | 7 | 9 | 8 | 8 |
| G603 | 8 | 7 | 8 | 9 | 8 |
| S604 | 9 | 9 | 8 | 9 | 8 |
| D605 | 9 | 9 | 9 | 9 | 9 |
| Average score (Pm) | 8.60 | 8.00 | 8.40 | 8.66 | 8.16 |
| Average weighted score (Pmp) | 1.90 | 1.77 | 3.72 | 5.76 | 5.43 |
| Total average weighted score (Pmt) | 18.5 | | | | |

The information presented in table 4 show us the fact that the sample obtained by warm smoking with sour cherry wood has met the best average score for the sensory characteristic represented by smell (8.66), while the colour gathered the lowest score (8.00).

Although the literature highlights the essence of sour cherry used in the smoking process, precisely for the colour given to the smoked product, this apply rather for cold smoking process, due to long term exposure to the action of smoke.

Table 5 Results interpretation regarding the general appearance of smoked samples

| Specification | n | Cold smoking | | Warm smoking | |
|---|---|---|---|---|---|
| | | sour cherry | beech | beech | sour cherry |
| | | P1 | P2 | P3 | P4 |
| $\overline{X} \pm s_{\overline{x}}$ | 6 | 8,67 ± 0.52 | 8,83 ± 0,41 | 8,50 ± 0,55 | 8,33 ± 0,82 |
| V% | 6 | 5,96 | 4,62 | 6,44 | 9,80 |
| Min | 6 | 8 | 8 | 8 | 7 |
| Max | 6 | 9 | 9 | 9 | 9 |
| Statistical significance | P1 vs P2 = n.s. ; F(0,3846) < Fα (4,9646) pt. 1:10 GL<br>P1 vs P3 = n.s. ; F(0,2941) < Fα (4,9646) pt. 1:10 GL<br>P1 vs P4 = n.s. ; F(0,7142) < Fα (4,9646) pt. 1:10 GL<br>P2 vs P3 = n.s. ; F(1,4285) < Fα (4,9646) pt. 1:10 GL<br>P2 vs P4 = n.s. ; F(1,8000) < Fα (4,9646) pt. 1:10 GL<br>P3 vs P4 = n.s. ; F(0,1724) < Fα (4,9646) pt. 1:10 GL | | | | |

The comparison of the average values obtained, regarding the overall appearance, between the four samples subjected to smoking, shows that there were no statistically significant differences.

Table 6 Results interpretation regarding the colour of smoked samples

| Specification | n | Cold smoking | | Warm smoking | |
|---|---|---|---|---|---|
| | | sour cherry | beech | beech | sour cherry |
| | | P1 | P2 | P3 | P4 |
| $\overline{X} \pm s_{\overline{x}}$ | 6 | 8.50 ± 0.55 | 8.67 ± 0.52 | 7.33 ± 0.52 | 8.00 ± 0.89 |
| V% | 6 | 6.44 | 5.96 | 7.04 | 11.18 |
| Min | 6 | 8 | 8 | 7 | 7 |
| Max | 6 | 9 | 9 | 8 | 9 |
| Statistical significance | P1 vs P2 = n.s. ; F(0,2941) < Fα (4,9646) pt. 1:10 GL<br>P1 vs P3 = **; F(14,4117) > Fα (10,0442) pt. 1:10 GL<br>P1 vs P4 = n.s. ; F(1,3636) < Fα (4,9646) pt. 1:10 GL<br>P2 vs P3 = **; F(20,0000) > Fα (10,0442) pt. 1:10 GL<br>P2 vs P4 = n.s. ; F(2,5000) < Fα (4,9646) pt. 1:10 GL<br>P3 vs P4 = n.s. ; F(2,5000) < Fα (4,9646) pt. 1:10 GL | | | | |

Statistically analysing the averages obtained by the four samples regarding sensory characteristics of colour, we notice distinctly significant differences between samples P1 vs P3 and P2 vs P3, differences due to the period of exposure to smoke and wood essences used in the smoking process.

Table 7 Results interpretation regarding the consistency of smoked samples

| Specification | n | Cold smoking | | Warm smoking | |
|---|---|---|---|---|---|
| | | sour cherry | beech | beech | sour cherry |
| | | P1 | P2 | P3 | P4 |
| $\overline{X} \pm s_{\overline{X}}$ | 6 | 8.33 ± 0.52 | 8.50 ± 0.55 | 7.67 ± 0.52 | 8.17 ± 0.75 |
| V% | 6 | 6.20 | 6.44 | 6.74 | 9.22 |
| Min | 6 | 8 | 8 | 7 | 7 |
| Max | 6 | 9 | 9 | 8 | 9 |
| Statistical significance | P1 vs P2 = n.s. ; F(0,2941) < Fα (4,9646) pt. 1:10 GL<br>P1 vs P3 = * ; F(5,0000) > Fα (4,9646) pt. 1:10 GL<br>P1 vs P4 = n.s. ; F(0,2000) < Fα (4,9646) pt. 1:10 GL<br>P2 vs P3 = * ; F(7,3529) > Fα (4,9646) pt. 1:10 GL<br>P2 vs P4 = n.s. ; F(0,7692) < Fα (4,9646) pt. 1:10 GL<br>P3 vs P4 = n.s. ; F(1,8000) < Fα (4,9646) pt. 1:10 GL | | | | |

Comparing the averages met by each sample regarding the sensory characteristic of consistency reveals that between cold and warm smoked sample with beech (P1 vs P3, P2 vs P3) are statistically significant differences. Thus conclude that specific temperature for each smoking method influence consistency of catfish meat.

Table 8 Results interpretation regarding the smell of smoked samples

| Specification | n | Cold smoking | | Warm smoking | |
|---|---|---|---|---|---|
| | | sour cherry | beech | beech | sour cherry |
| | | P1 | P2 | P3 | P4 |
| $\overline{X} \pm s_{\overline{X}}$ | 6 | 8.83 ± 0.41 | 8.50 ± 0.55 | 8.67 ± 0.52 | 8.67 ± 0.52 |
| V% | 6 | 4.62 | 6.44 | 5.96 | 5.96 |
| Min | 6 | 8 | 8 | 8 | 8 |
| Max | 6 | 9 | 9 | 9 | 9 |
| Statistical significance | P1 vs P2 = n.s. ; F(1,4285) < Fα (4,9646) pt. 1:10 GL<br>P1 vs P3 = n.s. ; F(0,3846) < Fα (4,9646) pt. 1:10 GL<br>P1 vs P4 = n.s. ; F(0,3846) < Fα (4,9646) pt. 1:10 GL<br>P2 vs P3 = n.s. ; F(0,2941) < Fα (4,9646) pt. 1:10 GL<br>P2 vs P4 = n.s. ; F(0,2941) < Fα (4,9646) pt. 1:10 GL<br>P3 vs P4 = n.s. ; F(1,6653) < Fα (4,9646) pt. 1:10 GL | | | | |

After analysing the mean values obtained regarding the sensory characteristic represented by smell, between the four samples subjected to the smoking process, there were no statistical differences.

Table 9 Results interpretation regarding the taste of smoked samples

| Specification | n | Cold smoking | | Warm smoking | |
|---|---|---|---|---|---|
| | | sour cherry | beech | beech | sour cherry |
| | | P1 | P2 | P3 | P4 |
| $\overline{X} \pm s_{\overline{X}}$ | 6 | 8 ± 0.00 | 8.67 ± 0.52 | 8.67 ± 0.52 | 8.17 ± 0.41 |
| V% | 6 | 0.00 | 5.96 | 5.96 | 5.00 |
| Min | 6 | 8 | 8 | 8 | 8 |
| Max | 6 | 8 | 9 | 9 | 9 |
| Statistical significance | P1 vs P2 =* ; F(10,000) > Fα (4,9646) pt. 1:10 GL<br>P1 vs P3 =* ; F(10,000) > Fα (4,9646) pt. 1:10 GL<br>P1 vs P4 = n.s. ; F(1,0000) < Fα (4,9646) pt. 1:10 GL<br>P2 vs P3 = n.s. ; F(1,6653) < Fα (4,9646) pt. 1:10 GL<br>P2 vs P4 = n.s. ; F(3,4615) < Fα (4,9646) pt. 1:10 GL<br>P3 vs P4 = n.s. ; F(3,4615) < Fα (4,9646) pt. 1:10 GL | | | | |

As for the sensory characteristic represented by taste, the statistical analysis shows us significant differences between P1 vs P2, P1 vs P3 samples. It is noted so that the wood essences used in the smoking process transmit specific taste, distinct, to the smoked product.

## CONCLUSIONS

Values obtained by sensory analysis of the smoked catfish meat, indicates the existence of some qualitative differences, according to the smoking method and type of wood used. However, the four samples taken in study have been assessed as "very good" in terms of quality, which indicates the suitability of this type of meat for superior capitalization through smoking.

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