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DETECTION AND COMPARISON OF THE SENSORY QUALITY OF WILD AND FARMED BROWN TROUT (*Salmo trutta*) BY CONSUMERS

Jurij POHAR [1]

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Detection and comparison of the sensory quality of wild and farmed brown trout (Salmo trutta) by consumers

To compare the sensorial quality of wild and farmed brown trout 34 consumer were asked to decide which of the two samples presented to them in double blind test was preferred regarding appearance, aroma, juiciness, mouth feeling and general impression if difference in mentioned traits between both samples was detected. Results showed that for all traits at least 75% of consumers stated that they noticed difference. For appearance and aroma wild trout was preferred, for juiciness and mouth feeling farmed trout was favored. General impression of wild brown trout was favored by 15 consumers, while 16 consumers regarding this trait preferred farmed brown trout. Meaning and importance of results from consumers' panel test for positioning of products from fish farming and fishery is discussed.

Key words: fish / brown trout / *Salmo trutta* / sensory quality / consumers / farming / fisheries

Zaznavanje in primerjava senzorične kvalitete prostoživečih in vzrejenih potočnih postrvi (Salmo trutta) pri porabnikih

V dvojnem slepem testu smo 34 porabnikov zaprosili, da povedo, ali so zaznali razlike glede izgleda, arome, sočnosti, okusa v ustih in splošnega vtisa med prostoživečimi potočnimi postrvmi in v ribogojnici vzrejenimi potočnimi postrvmi. Tiste, ki so razlike zaznali, smo zaprosili, naj povedo kateri od obeh vzorcev je bil glede na omenjene lastnosti po njihovem mnenju boljši. Rezultati so pokazali, da je za vsako od lastnosti najmanj 75 % porabnikov menilo, da so zaznali razliko med obema vzorcema. Glede izgleda in arome so dali prednost prostoživečim postrvim, glede sočnosti in okusa vzrejenim postrvim, glede splošnega vtisa pa je 15 porabnikov dalo prednost prostoživečim in 16 vzrejenim ribam. Pomen in pomembnost rezultatov, ki jih dobimo s tovrstnimi testi pri porabnikih smo vrednotili v kontekstu pozicioniranja rib in izdelkov, ki izvirajo iz akvakulture ali ribištva.

Ključne besede: ribe / potočna postrv / *Salmo trutta* / senzorična kakovost / porabniki / reja / ribolov

1 INTRODUCTION

The quantity of fish caught from populations living freely in fresh or sea waters (usually named as wild fish) has stayed around 90 million tones level since 2001. (FAO, 2010). In order to avoid overfishing it cannot be expected that the amount will increase in years to come. The enlarged market demand for fish is therefore provided by fish which are raised under controlled conditions. The practices of raising fish are similar to those used for terrestrial domestic animals which have been farmed for centuries; therefore for these fish the name usually used is "farmed fish". In the last years the increase of quantity of farmed fish has been enormous. An annual growth rate of 6.2% has been shown in the period from 2003 to 2008 and at present farmed fish represent more than 50% of total amount of fish supplied to market (FAO, 2010).

For some species due to such development consumers at the moment have the possibility to buy either wild or farmed fish of the same species. The phenomenon that the price of wild specimens is higher than the price of farmed ones has changed (Valderrama and Anderson, 2010). The willingness of consumers to pay premium price is caused by many factors. One of these factors could be the expectation of superior quality. The quality is a complex set of characteristics which is hard to define

1 Univ. of Ljubljana, Biotechnical Fac., Dept. of animal science, Groblje 3, Domžale, SI-1230, Slovenia, Assoc. Prof., Ph.D., M.Sc.

(for review see Schröder, 2003). Relatively few studies have focused on consumers' fish quality perception (Verbeke *et al.*, 2007) and perception the public has towards the consumption of farmed fish is poorly understood (Lofstedt and Schlag, 2010).

The majority of data from literature which compare quality of wild and farmed fish deals with chemical composition, nutritional value and other physical-chemical parameters. (Poli *et al.*, 2001; Alasalvar *et al.*, 2002; Grigorakis *et al.* 2003; Johnson *et al.*, 2006, Grigorakis, 2007). The research in this filed was focused mainly to sea bass (*Dicentrarchus labrax*) and sea bream (*Sparus aurata*) and to lower extent to Atlantic salmon (*Salmo salar*). Results presented by some authors indicate that there are differences in characteristics mentioned, however in some studies these differences have not been detected. There were only a few researches who try to compare organoleptic properties of wild and farmed fish. Such evaluations were usually done by panels of expert assessors. Fuentes *et al.* (2010) proposed that it would be of interest to carry out a sensory study to check if consumers detect differences observed between wild and cultured sea bass which were found by them for proximate composition, color and especially in texture, fatty acids and free amino acids profile. It could be stated that this is a marketing approach to the issue. As identified by Schröder (2003) technologists and consumers may not share the same value system regarding food products. According to same author the purely natural-scientific approach to food quality management is no longer appropriate. The position of quality of fish in the mind of consumer is not determined merely by the chemical composition, nutritional value and other physical-chemical characteristics or sensorial quality assessed by panel of experts. Even when the difference exists and can be objectively evaluated it is of value for consumers only if they are able to detect it as the difference in culinary value.

The aim of our work was to find out if consumers in double blind test would distinguish between wild and farmed brown trout (*Salmo trutta*) with regards to some characteristics related to culinary pleasure, and to find out which fish (farmed or wild) concerning these characteristics, is preferred by consumers.

2 MATERIALS AND METHODS

In this work 34 brown trout from two origins (farmed and wild) were used, 17 fish from each origin. Wild fish were caught by fly fishing technique in different Slovenian rivers. Only fish of size similar to portion size of farmed trout were kept, the fish which were too small or too large were released. The fish were eviscerated immediately after they were caught and kept on ice until they were deep-frozen. All the wild fish were not caught in one day but on different days during the period of two weeks. The amount of fish caught on specific day differs from day to day. The farmed trout were purchased in the local fish market. On specific day the number of fish bought was equal to the number of fish caught on preceding day. The procedure with farmed fish equals to the procedure with wild fish. One day before the consumer panel was performed fish were unfrozen at room temperature and thereafter kept in refrigerator until they were prepared to be tested by members of consumer panel. The consumer panel consisted of 34 members; 18 females, 16 males. The age of majority of panel members was between 30 and 50 years (68%), 23% were older than 50 years and 9% younger than 30 years. During the recruiting procedure the question about fish culinary knowledge and frequency of fish eating was asked to potential participants; those considered themselves as average connoisseurs regarding fish gastronomy and not having more than one dish per week or less than one dish per months were invited to participate. Each member of the panel was served one sample of wild and one sample of farmed brown trout. Fish were prepared the way which is considered to be the most common cooking practice for trout in this region; after being salted (20 grams of salt per 1000 grams of fish) and floured (mixture of wheat flour type 400 and 500) they were for 15 to 20 minutes pan-fried in refined sunflower oil heated to 170–190 °C. Before frying, the head of fish was removed (transversal cut at the end of gill cover). By transversal cut at the end of back fin two parts (front – from end of the gill cover till the end of the back fin; rear – from the end of the back fin till the end of the tail) were made. At one time in the same pan one piece of rear (or front) part of wild and farmed trout was cooked. The samples were coded. The origin of samples was known only to researchers and not to technical stuff which cooked and served fish. Since we wanted to simulate the common way the trout is consumed, the settings of consummation was similar to home or restaurant ambient and not to the sensory analysis lab.

Samples were presented to each participant on two coded serving plates. Each consumer was asked to decide if he/she noticed difference regarding appearance, aroma, juiciness, mouth feeling and general impression. If the answer was affirmative, the panelists were asked to choose the sample which they prefer regarding the characteristics mentioned. For each trait consumers had also the possibility to state that they did not detect difference between samples.

Subsequently the same procedure was repeated but this time two samples of rainbow trout (*Oncorhynchus*

Table 1: *Numbers and percentage of consumers who were indecisive and those who preferred brown trout of one or another origin (non-indecisive consumers)*
Preglednica 1: *Število in odstotek tistih sodelujočih, ki niso zaznali razlike in tistih, ki so dali prednost potočni postrvi enega ali drugega izvora*

Characteristics	Non-indecisive consumers, number	Indecisive consumers, number	Non-indecisive consumers, %	Indecisive consumers, %
Appearance	28	6	82.4	17.6
Aroma	26	8	76.5	23.5
Juiciness	32	2	94.1	5.9
mouth feeling/	31	3	91.2	8.8
general impression	31	3	91.2	8.8

mykiss) which did not differ in origin (both samples originated from same fish farm) were appraised by consumers. This step was done to evaluate the sensitivity of recognition of possible difference in brown trout of different origins by consumers.

Results were statistically evaluated using the method of χ^2.

3 RESULTS AND DISCUSSION

The number of consumers who claimed to distinguish between both samples and the number and percentage of those who were indecisive is presented in Table 1.

It is clear that the majority of panelists gave the preference to one or other sample regarding characteristics appraised. However the percentage of those who did not find differences between samples was not the same for all characteristics. There were almost one quarter (8 out of 37) who did not notice differences regarding aroma, while there were less than 10% of those who were undecided regarding preferences for juiciness (2 out of 34) as well as mouth feeling and general impression (3 out of 34).

Yet the decision for preference was not unanimous. For each trait some panelists gave preferences for wild and some for farmed fish. Table 2 presents the numbers and percentages among all non- indecisive panelists who gave preference regarding appearance, aroma, juiciness, mouth feeling and general impression to either wild or farmed trout.

The characteristics could be clustered into three groups. In the first group there are appearance and aroma - regarding these characteristics around two thirds of participants preferred wild brown trout. The second group is represented by mouth feeling and juiciness – concerning these characteristics consumers preferred farmed trout. The third group is represented by general impression. The number of participants who prefer wild fish for this characteristic is almost the same as the number of panelists who prefer farmed fish. χ^2 values and their probabilities are presented in Table 3. From this table it is clear that only for juiciness the null hypothesis (the number of participants who have a preference for wild fish is the same as number of participants who have preference for farmed fish) could be rejected with high probability

Since null hypothesis could be rejected with high probability only for one characteristic, the question was raised whether consumers' perception of differences between samples in other traits were really detected or difference observed was simply the matter of chance due to

Table 2: *Numbers and percentage of non-indecisive consumers preferring either wild or farmed brown trout*
Preglednica 2: *Število in odstotek sodelujočih, ki so dali prednost prostoživeči ali vzrejeni potočni postrvi, med vsemi, ki so zaznali razliko*

Characteristics	Wild preferred *number*	Farmed preferred/ *number*	Wild preferred %	Farmed preferred %
Appearance	18	10	64.3	35.7
Aroma	18	8	69.2	30.8
Juiciness	7	25	21.9	78.1
mouth feeling	13	18	41.9	58.1
general impression/	15	16	48.4	51.6

Table 3: *χ^2 values and probabilities*
Preglednica 3: *χ^2 vrednosti in verjetnosti*

Characteristics	χ^2 values	P-value
appearance	2.2857	0.1306
aroma	3.8462	0.0499
juiciness	10.1250	0.0015
mouth feeling	0.8065	0.3692
general impression	0.0323	0.8575

the fact that consumers did not want to be indecisive. If this would be the case, we would expect that the ratio between non-indecisive and indecisive answers when samples would not differ in origin; would be similar to those found with samples of different origin.

In Table 4 the percentages of consumers who stated that they did not recognize the difference between two samples which were of the same origin, are presented. The percentages of indecisive answers are lower than

Table 4: *Numbers and percentage of consumers who were indecisive and those who preferred one or another sample of same origin (non-indecisive consumers)*
Preglednica 4: *Število in odstotek tistih sodelujočih, ki niso zaznali razlike in tistih, ki so dali prednost enemu od obeh vzorcev enakega izvora*

Characteristics	Non-indecisive consumers, number	Indecisive consumers, number	Non-indecisive consumers, %	Indecisive consumers, %
appearance	20	14	58.8	41.2
aroma	19	15	55.9	44.1
juiciness	25	9	73.5	26.5
mouth feeling	26	8	76.5	23.5
general impression	24	10	70.6	29.4

Table 5: *Numbers and percentage of non-indecisive consumers preferring sample one or sample two*
Preglednica 5: *Število in odstotek sodelujočih, ki so dali prednost prvemu in drugemu vzorcu med vsemi, ki so zaznali razliko*

Characteristics	Sample 1 preferred number	Sample 2 preferred number	Sample 1 preferred %	Sample 2 preferred %
appearance	9	11	45.00	55.00
aroma	11	8	57.89	42.11
juiciness	15	10	60.00	40.,00
mouth feeling	12	14	46.15	53.85
general impression	11	13	45.83	54.17

those presented in Table 1. This is true for all characteristics. However, there are still a large number of consumers who stated that they noticed difference between two samples even samples were not from different origin.

When we closely check the responses from consumers who expressed preference for one or another sample we realized that the percentage of those who gave preference for sample one was very similar to the percentage of those preferring sample two. These results are shown in Table 5.

The largest difference in the percentage was observed for juiciness; 15 consumers (60%) out of 25 stated that sample one was preferred in contrast to 10 consumers (40%) who expressed their preference for sample two. The difference between numbers of consumers preferring either sample one or sample two were lower for other characteristics. Since both samples did not differ in origin it was expected that all χ^2 values would be low. χ^2 values and their probabilities are presented in Table 6. They indicate that the null hypothesis (the number of participants who prefer sample one is the same as number of participants who have preference for sample two) cannot be rejected.

Table 6: *χ^2 values and probabilities*
Preglednica 6: *χ^2 vrednosti in verjetnosti*

Characteristics	χ^2 values	P-value
appearance	0.2000	0.6547
aroma	0.4737	0.4913
juiciness	1.0000	0.3173
mouth feeling	0.1538	0.6949
general impression	0.1667	0.6831

4 CONCLUSIONS

Since we did not have data on chemical composition, nutritional value and other physical-chemical parameters of wild and farmed brown trout used in sensorial evaluation we cannot answer to the question set by Fuentes *et al.* (2010) about ability of consumers to detect possible differences between groups regarding parameters mentioned. However, the comparison of data from test where two groups of brown trout of different origin were evaluated by consumers, with data from test where two groups of trout were of same origin, indicates that consumers gave preference to one group on the basis of real detected difference. The differences in numbers of participants who favored either wild or farmed trout were for all traits excluding juiciness small. Therefore it was not possible to conclude with high statistical probability that wild trout is preferred regarding appearance and aroma, while farmed trout is preferred regarding mouth feeling. There is no preference regarding general impression. For the last trait the possible explanation could be that the preference differs between participants; regarding general impression some prefer wild and some farmed trout. Concerning juiciness consumers exhibited clear preference for farmed trout. It can be speculated that this is due to higher fat content. Grigorakis (2007) believe that muscle juiciness depends on the muscle fat content rather than on moisture content. Our results were not in agreement with existing literature data where in comparisons wild fish appear to be superior to farmed fish. (Webster *et al.*, 1993; Grigorakis *et al.*, 2003). Nevertheless conclusions found in the literature were made on limited numbers of panelists and were rather uncritical. For instance in the research of Grigorakis *et al.* (2003) 2 out of 12 assessors showed no preference, 2 preferred farmed and 8 wild sea bream. Calculation of χ^2 done by us is too small to support their conclusion that "a superiority of wild fish is strongly indicated".

It is important to underline that fish in our research were not prepared, served and tested under conditions which are suggested by standard procedure of sensorial analysis like one proposed by ISO (2005). Our intention was to compare wild and farmed brown trout in such a manner that the culinary experience would be as close to real eating situation as possible. It could be argued that the way fish were prepared was not the best to enable consumers to reveal possible differences between farmed and wild trout in sensorial traits caused by chemical composition, nutritional value and other physical-chemical parameters to maximum extend. However as indicated by Raats *et al.*(1995), sensory preference is an indicator of food acceptability which could or could not be a predictor of the consumer's behavior. At the same time only the sensorial experience consumer run through by himself/herself are relevant for his/her behavior. The information about sensorial evaluation from researches which are designed to reveal if differences in chemical composition, nutritional value and other physical-chemical parameters can be detected, influence the behavior of consumer who does not participate in the assessment, only indirectly in same manner as other information which industry, government or other stakeholder use to build the position of specific food, brand or item. Of course if the appearance, aroma, juiciness, mouth feeling or general impression of specific product is preferred by specific marketing segment, the process of positioning one product above other is easier. According to our results and results found in literature we can conclude that difference in position of wild and farmed fish in future will be to lesser extent based on an objective difference in chemical and physical-chemical characteristics which are influencing sensorial characteristic (not necessarily appraised by consumers in everyday culinary experience) but to a larger extent to dimensions of farmed and wild fish related to health, environment and economy. Namely at present the European public is concerned with production method rather than the end product (Lofster and Schlang 2010).

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