# The Quality Perceptions of Rainbow Trout Defined by different Fish Market Sectors

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**Abstract**: In this study we apply Analytical Hierarchy Process (AHP) to examine the similarities and differences of the quality perceptions of different fish market sectors. In order to make this analyse, a hierarchic model of the total quality of fresh rainbow trout *(Oncorhyncus mykiss)* fillets was created. The model had seven main criteria and 78 sub-criteria at different levels. Computer-based interviews were carried out with 18 wholesalers, 20 retailers and 17 representatives of catering sector. The interviewees attached weight to each element of the model according to their relative importance. The main criteria were raw material, sensory quality, freshness, safety, nutrition, service and image. Freshness was the most significant component of the quality of fresh rainbow trout fillet. Among the sectors there were noticeable similarity about the significance of freshness to the quality. Concerning the other main criteria there were considerable differences in the quality perceptions. Most components connected with sensory quality, safety and nutrition were seen more important by catering sector than wholesalers or retailers. Wholesalers considered components connected with raw material and service more important than other sectors.

**Keywords**: Total quality, seafood quality, analytical hierarchy process, fish markets

## 1.     INTRODUCTION

The farmed rainbow trout (Oncorhyncus mykiss) is nowadays the most valuable domestic fish species in Finnish fish markets (Setälä et al. 1998) The intensive farming of rainbow trout began in Finland in the beginning of 1980's. The production increased fast, and by the end of 1980's the total production was about 18 million kilos. Finnish fish production and trade chain comprise usually of three or four levels before final consumption. Fish farmers sell gutted rainbow trout to the wholesale companies, where the primary processing take place. The most common product is fillet. Fresh fillets are in most of the cases delivered to retailing companies and catering establishments, who sell them to final consumption. Smaller but growing share of fillets is sold via secondary processors or distributors. About 30 per cent of rainbow trout fillets was consumed by catering sector in 1994 in Finland (Honkanen 1996).

Since the middle of 1990's import barriers for fresh salmon were abolished, the domestic production encountered an increasing competition by imported salmon. The size of marketable rainbow trout in Finland is bigger than in the other European countries, and thus rainbow trout and Atlantic salmon (Salmo Salar) compete in the same fresh fish market. Due to the intensified competition the profitability of fish farming has decreased and the market share of domestic producer has diminished. Better quality along with competitive pricing has mentioned to be the major reasons for the success of imported salmon in Finland.  Quality improvements along the whole fish trade chain are seen as one effective way to increase the competitiveness of Finnish fish industry.

The measures for improving the quality have to be based on a clear understanding of factors affecting product quality in the fish trade chain. Fish traders should know their customers' quality perceptions and the whole market chain should co-operate for the collective quality goal in order to satisfy the needs of final consumers. However, quality itself is a broad and complex concept and can be defined in many different ways.

Quality can be approached from production processes (Demming 1982, Ishiwaga 1985, Juran 1988) or from customer based view (Oakland 1995). According to Feigenbaum (1991) quality is all those criteria in the whole organisation's marketing, planning, and manufacturing of the product or service, which satisfy the needs of certain customers.  The quality of seafood is a

diverse set of physical, microbiological and nutritional attributes, which can be affected by many factors in the different level of production and trade processes. In addition, final customers consider safety as important element in the fish quality. The prioritising of different elements in fish quality may substantially differ between the market sectors and even among individuals within the same sector.

Analytical Hierarchy Process (AHP) offers a method to organise complex structures and measure priorities (Saaty 1980). It allows to consider and synthesise different kinds of elements in an understandable entity, which can be mathematically evaluated. In this study we apply AHP in structuring and clarifying the concept of total quality of fresh fish. The production and consumer related elements of total quality are connected to one hierarchic model and the priorities of the wholesalers, retailers and representatives of catering establishments are measured.

The paper is henceforward organised in three main sections. First, in the methodological section we present theoretical background of AHP relevant for this study, the method used for developing the total quality model and decomposing and weighting the elements in the model are introduced. In the same section the samples studied and analysis methods are briefly introduced. The obtained results are presented in section three and in the last section the main results are discussed.

## 2. METHODS

### 2.1 Theory of decision analysis

AHP originally developed by Saaty (1980) has proven to be a useful tool to rationalise decision making. It has been applied to contribute the understanding in various types of decision problems (Arbel and Orgel, 1990, Hämäläinen, 1990, Srinivasan and Bolster, 1990). AHP organises the basic rationality by breaking down a problem into its smaller constituent parts. By decomposing the problem, the decision-maker can focus on a limited number of items at the same time. AHP is carried out in two phases: structuring the hierarchy and evaluating the priorities of the decision maker.

In the first phase a complex decision problem is arranged in the form of a hierarchy, which descends from generally stated objectives to more practical operational criteria. The criteria with global and abstract character are at the higher levels of the hierarchy, others specifying characters in greater depth are at lower levels. The single top-level factor is the overall goal of the decision making. The elements at each level in the hierarchy are assumed to be independent of the elements in the other part of the hierarchy. Also the criteria in each level shoud be the same order of magnitude, so the decision-maker could compare homogenous criteria accurately (Vargas 1990). In principle the structure of the hierarchy is not required to be symmetrical. The hierarchy may consist of a different number of subcriteria at each level, and the number of levels can vary. As long as the person comparing the criteria is rational, the framing of the problem will not affect the results. Kahneman and Tvarsky (1984) have, however, criticised this assumption and showed that at least in certain situations framing can be essential.

In the evaluation phase the criteria at the same level are compared with each other in relation to their importance to the criterion above the criteria being compared. In AHP the evaluation is normally based on the concept of paired comparisons, which enable analysis of the consistency of the individual prioritisation. The evaluation can also be carried out by direct rating, which is easier and faster technique in the case that the hierarchy is wide and consist of numerous elements.

In this study Simple Multiattribute Rating Technique (SMART) developed by Hämäläinen and Lauri (1992) was utilised. In SMART-technique the interviewee prioritise simultaneously all the elements at the same level. The mathematics behind the rating technique is shortly described by an illustrative example in Appendix 1. The choice of rating method was directed by the fact that too time-consuming interviews might risk the whole process. In the test-interviews the comparisons in pairs lasted over three hours. The representatives of market sectors were individually interviewed with assistance of interactive microcomputer decision software package HIPRE (HIerarchial PREference analysis) (Hämäläinen and Lauri 1992). HIPRE enabled adaptable interviews, interviewees could re-evaluate weights with visible rating-aid and the interviewer could make simultaneous corrections.

Although the AHP has been engaged to support individual decision making process, it has been used in group settings as well. In applying the AHP in small group settings it is predicted that groups should be homogenous (Zahir 1999a). Both arithmetic mean and geometric mean method are used in synthesising individual decision of a homogenous group into a group decision (Zahir 1999b). In this study we use arithmetic mean in order to broaden the individual judgements in to a group decision.

## 2.2 The Hierarchic Model Of The Total Quality Of A Rainbow Trout Fillet

The hierarchic model of total quality of rainbow trout was developed stepwise in following way. Firstly, based on expertise from Finnish Game and Fisheries Research Institute and literature concerning total quality (Demming 1982, Ishiwaga 1985, Juran 1988, Feigenbaum 1991, Oakland 1995), and fish quality (Connell 1980, Dore 1990, Sørensen 1992, Børrensen1992) all concepts and elements, which could be important part of the model was identified and listed.

In the second phase the elements were organised in a form of hierarchy, where the good quality of fresh rainbow trout fillet was stated as the overall goal at the highest level. The elements at the main level were selected so that they composed clear separate entities. The subcriteria at the same levels were chosen so that they compose homogenous groups. The structure was modified in co-operation with quality experts from the University of Helsinki. In this stage factors affecting the purchasing event like product image and PR were added to the traditional concept of product quality.

After test interviews with fish quality and fish market experts, the structure was simplified and the definitions of the components were clarified. This was done in order to assure that the criteria would be independent and the risk for multi-collinearity between the criteria would be diminished (see Vargas 1990).

The final hierarchy is presented in Figure 1. The model consisted of seven elements at the main level: raw material, sensory qualities, freshness, safety, nutrition, service and image. Every main criterion was further divided into several, altogether 78, subcriteria. The detailed contents of each criterion is described in Appendix B. A short description of the content of the main criteria is given below.

Raw material consisted of subcriteria concerning the physical features of whole unprocessed rainbow trout and the effect of cultivation environment to quality of the raw material. Sensory qualities concerned the appearance, taste, odour and texture of rainbow trout fillets. Freshness meant the factors affecting hygiene and conservation. Safety included elements dealing with risks to individuals and environment. Nutrition contained the health effects of fish products. Service concerned the supportive activities needed in the selling and purchasing of rainbow trout fillet. Image meant the image of the product, purchasing surroundings and company.

## 2.3 The Interviews

Altogether eighteen fish wholesalers, twenty retailers and seventeen representatives of catering establishments in southern Finland were interviewed.

The interviewed wholesalers were selected among the biggest companies in the study area. They represented about one quarter of the total sales of fish in Finland. Rainbow trout was the most important fish species for half of the companies. All wholesalers, except one, filleted rainbow trout. Fresh fish was the most important product for 60 percent of the companies. Half of the wholesalers sold fish directly to retailers and the rest of them through other fish distribution companies.

The interviewed retails were randomly selected from the A.C. Nielsen retail-register (Nielsen 1996) among the supermarkets with sales over FIM 20 million. The companies were settled in the city of Helsinki and the surrounding areas. The interviewed sales personal were employed in a separate fish department and they were in charge of purchasing fish products.

The interviewed representatives of catering establishments were randomly selected among the biggest catering establishments in southern Finland from A.C. Nielsen catering-register (Nielsen 1995). The interviewed catering establishments served daily at least 1 400 portions, while the biggest catering establishments served daily over 120 000 portions. Most of interviewed catering establishments served to public institutions e.g. schools, hospitals and army corps. Two of interviewed establishments were personal catering kitchens and none were commercial restaurants. The people interviewed were in charge of purchasing food supplies. Rainbow trout was the most important domestic fish for these catering establishments. Honkanen (1996) has evaluated that 70 percent of rainbow trout is purchased fresh in catering sector.

The interviews were carried out in two phases. The wholesalers and retailers were interviewed in June to August 1996. The preliminary results of this interview was presented by Honkanen et al. (1997) The study was completed by the interviews of catering establishments in April and May 1998. Both phases were realised equally. In the beginning of the interview, the hierarchic model, the context of the criteria and the rating system, were carefully explained to the interviewees. In the evaluation phase, the interviewees were first asked to prioritise the seven criteria at the main level, and after that the subcriteria under each main criteria level by level. In addition to the numerical rating, each interviewee was
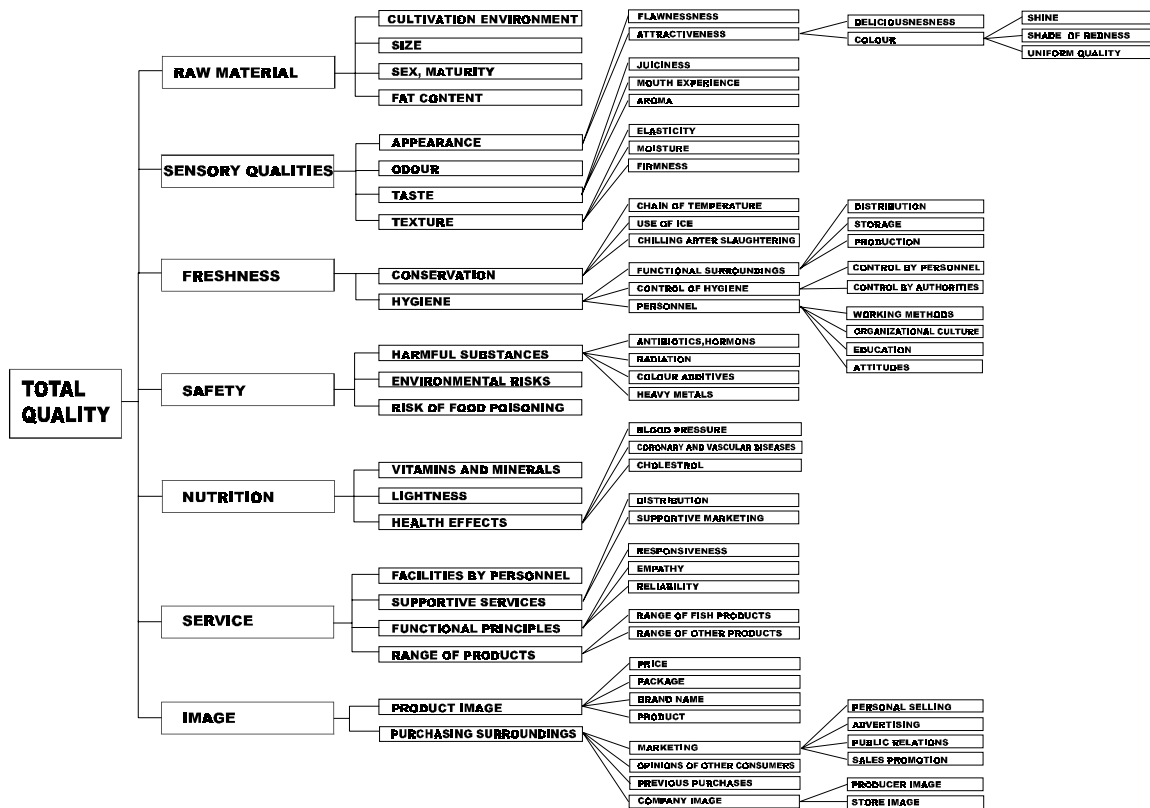
**Figure 1.** The hierarchic model of the total quality of fresh rainbow trout fillet

shown a bar-chart illustrating their evaluation in order to lower inconsistency in answers.

The time spent with each person interviewed varied from 45 minutes to two hours, the average being one hour and 30 minutes. The interviews were mainly carried out on company premise. Most of interviewees were interested in the study. The questions were generally well accepted, although the highest level of the model was often described as "difficult" to answer. The contents of criteria at the other levels were more concrete and thereby easier to understand for most interviewees. The interviewees were given the opportunity to change their earlier prioritisations, if the meaning of a specific criteria became clear during the interview. The majority of the interviewees in wholesale or retail sector were men and in the catering sector all interviewed were women.

**2.4     Analyses**

In order to analyse the quality perception of the groups the arithmetic mean of the element weights of criteria were calculated (Table 1). The variation of the answers within the groups was examined with the coefficient of variation and the quartiles.

The similarities and differences of the quality perceptions were tested against the hypothesis that the means of the global weights (global weight is defined in Appendix 1) of different fish market sectors are the same. This was tested for every main criteria and the subcriteria at the last level with t-test (Table 2).

**3.     RESULTS**

The quality perceptions were relatively homogenous between wholesalers and retailers, but there were significant differences between the catering establishments and other sectors (Tables 1 and 2). According to t-test only one of the last level criterion differed very significantly (in 99% confidence level) between wholesalers and retailers. The opinions of wholesalers and the representatives of catering sector differed most. The difference was statistically very significant in the case of 6 main criteria and 19 last level criteria. Corresponding figures were 2 and 17 between retailers and catering establishments.

Despite of the substantial differences there was one clear similarity in the quality perceptions. All sectors regarded
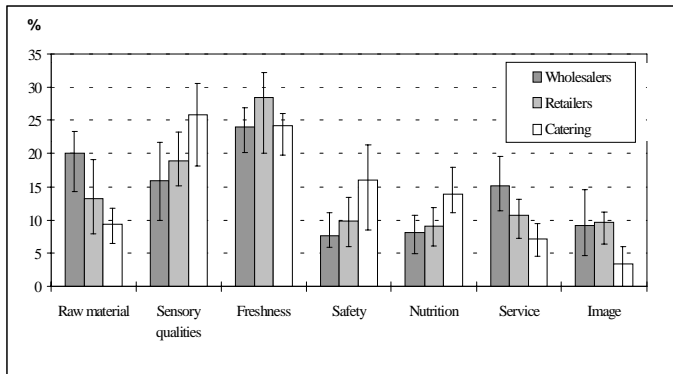
**Figure 2.** The average importance attached by wholesalers, retailers and catering sector to the main criteria. The bar indicates the 1st and 3rd quartiles

*freshness* as one of the most important part of the total quality of rainbow trout fillet (Figure 2). Wholesalers and retailers saw it as the most important and catering sector as the second most important element. The coefficient of variation was low in every sector. All market sectors considered that conservation and hygiene had almost equal effects on freshness. The wholesalers regarded that the immediately chilling after slaughter is the most important factor affecting to the conservation, retailers and catering establishment did not see much difference between compared factors. All actors considered that personnel has the most important effect on hygiene and the control of hygiene the least importance on hygiene. All actors clearly preferred control by personnel a head of control by authorities.

The most significant differences between wholesalers and retailers concerned main criteria, *raw material* and service. Wholesalers saw raw material more important element of total quality than retailers.

Wholesalers considered the cultivation environment as well as sex and maturity to be significantly more important than size and fat content. The retailers weighted all subcriteria almost equally. On the contrary the catering establishment regarded raw material relatively insignificant factor, besides according to them

sex and maturity had the least effect to quality of raw material.

*Sensory qualities* was the most important quality attribute for catering sector. Catering establishments emphasised it noticeably more than wholesalers or retailers. In addition they saw that taste and odour are the most significant components while wholesalers and retailers preferred appearance. The catering establishments considered that main criteria *safety* had relatively high importance to total quality. On the contrary wholesalers and retailers considered it as the least or second least important element. The catering sector saw also the risk of food poisoning and radiation more significant threat to safety than other sectors. Also *nutrition* was regarded more significant by catering establishments than others. They saw that vitamins and minerals and health effects were important factors to nutrition.

*Service* appeared to be more important to the wholesalers than to the retailers. Service was the least prioritised by representatives of the catering sector. The wholesalers considered that facilities by personnel have significantly more importance on service than others did. The retailers regarded functional principles as the most important element. Supportive services was the second important factor for the retailers, but least valued by the wholesalers.

All actors considered *image* rather unimportant. Especially the catering establishments regarded it as insignificant factor. Almost all criteria connected with image were significantly less important by the catering sector than others. The wholesalers and the retailers regarded that package and brand are less significant elements of product image than price. The wholesalers considered that company image has high importance on purchasing surroundings The wholesalers valued store image and producer image significantly more than the retailers did. The wholesalers and the retailers considered that the personal selling is the most effective marketing method.

**Table 1.** The average weights and the coefficients of variation of the criteria at the last level

| | Wholesalers | | Retailers | | Catering sector | |
|---|---|---|---|---|---|---|
| | Avarage | *CV %* | Avarage | *CV %* | Avarage | *CV %* |
| **RAW MATERIAL** | 0,200 | *58,5* | 0,133 | *53,1* | 0,094 | *51,8* |
| Cultivation environment | 0,076 | *118,3* | 0,041 | *76,5* | 0,036 | *87,0* |
| Size | 0,027 | *73,2* | 0,029 | *87,5* | 0,025 | *89,5* |
| sex, maturity | 0,065 | *62,8* | 0,035 | *72,7* | 0,009 | *170,9* |
| fat content | 0,032 | *70,1* | 0,028 | *44,9* | 0,024 | *97,8* |
| **SENSORY QUALITIES** | 0,159 | *51,9* | 0,188 | *38,3* | 0,259 | *44,8* |
| Odour | 0,036 | *76,9* | 0,041 | *53,5* | 0,067 | *57,2* |
| Flawnessness | 0,027 | *83,5* | 0,029 | *52,7* | 0,031 | *48,9* |
| Juiciness | 0,013 | *86,5* | 0,011 | *55,9* | 0,023 | *64,9* |
| mouth experience | 0,010 | *80,3* | 0,012 | *75,8* | 0,026 | *64,3* |
| Aroma | 0,011 | *86,5* | 0,012 | *73,4* | 0,025 | *74,5* |
| Elasticity | 0,014 | *74,4* | 0,015 | *58,1* | 0,021 | *89,5* |
| Moisture | 0,009 | *65,2* | 0,015 | *73,2* | 0,015 | *87,0* |
| Firmness | 0,015 | *73,2* | 0,020 | *62,4* | 0,023 | *86,2* |
| shine of color | 0,004 | *72,0* | 0,005 | *91,2* | 0,003 | *81,9* |
| shade of redness | 0,007 | *71,5* | 0,009 | *76,4* | 0,006 | *59,6* |
| colour of uniform quality | 0,005 | *76,8* | 0,007 | *70,1* | 0,006 | *78,5* |
| **FRESHNESS** | 0,240 | *18,4* | 0,285 | *42,7* | 0,242 | *24,7* |
| chain of temperature | 0,037 | *33,6* | 0,048 | *42,9* | 0,045 | *33,3* |
| use of ice | 0,039 | *38,1* | 0,040 | *49,0* | 0,035 | *50,9* |
| chilling after slaughtering | 0,053 | *28,9* | 0,051 | *71,0* | 0,046 | *47,4* |
| Distribution | 0,011 | *57,0* | 0,016 | *64,3* | 0,013 | *53,1* |
| Storage | 0,014 | *55,1* | 0,015 | *50,7* | 0,013 | *43,0* |
| Production | 0,015 | *61,2* | 0,016 | *59,3* | 0,015 | *51,5* |
| hygiene control by personell | 0,013 | *76,3* | 0,023 | *63,6* | 0,025 | *44,1* |
| hygiene control by authorities | 0,006 | *94,7* | 0,009 | *104,3* | 0,007 | *106,8* |
| working methods | 0,014 | *55,3* | 0,016 | *53,2* | 0,014 | *69,1* |
| Organizational culture | 0,013 | *41,7* | 0,013 | *81,7* | 0,009 | *71,5* |
| Education of porsonell | 0,008 | *88,7* | 0,013 | *71,7* | 0,009 | *56,9* |
| attitudes of personell | 0,016 | *50,6* | 0,026 | *108,1* | 0,011 | *55,2* |
| **SAFETY** | 0,076 | *51,4* | 0,099 | *55,3* | 0,160 | *61,9* |
| Environmental risks | 0,026 | *91,4* | 0,023 | *114,4* | 0,039 | *73,6* |
| risk of food poisoning | 0,009 | *127,8* | 0,015 | *136,3* | 0,052 | *62,3* |
| risk by antibiotics, hormons | 0,023 | *74,3* | 0,026 | *119,0* | 0,020 | *160,0* |
| risk by radiation | 0,004 | *141,0* | 0,007 | *126,5* | 0,016 | *71,5* |
| risk by colour additives | 0,007 | *106,0* | 0,011 | *115,3* | 0,010 | *98,0* |
| risk by heavy metals | 0,006 | *115,2* | 0,016 | *131,3* | 0,023 | *103,8* |
| **NUTRITION** | 0,081 | *59,4* | 0,091 | *54,4* | 0,139 | *37,9* |
| vitamins and minerals | 0,018 | *128,5* | 0,020 | *84,4* | 0,054 | *48,4* |
| Lightness | 0,029 | *71,7* | 0,044 | *60,3* | 0,030 | *58,3* |
| blood pressure | 0,009 | *74,6* | 0,007 | *89,7* | 0,020 | *53,3* |
| coronary and vascular diseases | 0,015 | *97,1* | 0,008 | *94,8* | 0,017 | *44,6* |
| Cholesterol | 0,010 | *83,6* | 0,011 | *108,0* | 0,017 | *48,2* |
| **SERVICE** | 0,152 | *41,1* | 0,107 | *49,2* | 0,071 | *57,5* |
| facilities of personell | 0,048 | *57,5* | 0,019 | *61,6* | 0,018 | *65,2* |
| Distribution | 0,014 | *71,6* | 0,016 | *45,6* | 0,010 | *82,0* |
| Supportive marketing | 0,010 | *89,3* | 0,012 | *70,1* | 0,002 | *166,3* |
| Responsiveness | 0,012 | *63,2* | 0,010 | *75,0* | 0,006 | *85,1* |
| Empathy | 0,012 | *66,3* | 0,009 | *90,3* | 0,006 | *86,8* |
| Reliability | 0,020 | *51,9* | 0,015 | *57,8* | 0,012 | *78,5* |
| fish sortiment | 0,028 | *53,0* | 0,020 | *80,1* | 0,012 | *118,7* |
| other products | 0,008 | *114,5* | 0,005 | *91,9* | 0,004 | *155,4* |
| **IMAGE** | 0,091 | *63,0* | 0,096 | *54,6* | 0,034 | *100,9* |
| Price | 0,021 | *79,7* | 0,021 | *52,0* | 0,011 | *101,2* |
| Package | 0,009 | *84,9* | 0,009 | *92,6* | 0,005 | *135,4* |
| brand name | 0,007 | *85,9* | 0,006 | *99,0* | 0,002 | *154,3* |
| Product | 0,018 | *65,1* | 0,024 | *69,5* | 0,008 | *112,2* |
| opinions of other consumers | 0,006 | *89,2* | 0,008 | *69,1* | 0,002 | *196,2* |
| previous purchases | 0,011 | *76,7* | 0,011 | *45,3* | 0,003 | *157,3* |
| personal selling | 0,003 | *127,5* | 0,003 | *67,9* | 0,000 | *137,2* |
| Advertising | 0,002 | *170,3* | 0,003 | *77,2* | 0,000 | *176,5* |
| public relations | 0,002 | *114,6* | 0,001 | *80,9* | 0,000 | *187,1* |
| sales promotion | 0,002 | *107,9* | 0,002 | *83,2* | 0,000 | *153,5* |
| producer image | 0,005 | *101,7* | 0,002 | *107,9* | 0,001 | *168,8* |
| store image | 0,006 | *93,2* | 0,007 | *92,4* | 0,002 | *176,8* |

**Table 2.** T-tests of the main criteria and subcriteria at the last level: T-tests of the main criteria and sub-criteria at the last level: H₀: the averages of the wholesalers and retailers are the same. H₀: the averages of the wholesalers and catering sector are the same. H₀: the averages of the retailers and catering sector are the same.

(* = 90% confidence level, ** = 95% confidence level, *** = 99% confidence level)

| Criterion | Retailers = Wholesalers | Wholesalers = Catering sector | Retailers = Catering sector |
|---|---|---|---|
| **RAW MATERIAL** | **2,12 \*\*** | **3.54 \*\*\*** | **1.97 \*** |
| cultivation environment | 1,57 | 1.78 * | 0.48 |
| size | -0,26 | 0.37 | 0.58 |
| sex, maturity | 2,67 ** | 5.36 *** | 3.74 *** |
| fat content | 0,76 | 1.03 | 0.56 |
| **SENSORY QUALITIES** | **-1,15** | **-2.91 \*\*\*** | **-2.18 \*\*** |
| odour | -0,60 | -2.73 ** | -2.49 ** |
| flawnessness | -0,33 | -0.63 | -0.39 |
| juiciness | 0,60 | -2.35 ** | -3.15 *** |
| mouth experience | -0,70 | -3.35 *** | -2.97 *** |
| aroma | -0,55 | -2.83 *** | -2.53 ** |
| elasticity | -0,57 | -1.50 | -1.20 |
| moisture | -2,14 ** | -1.88 * | -0.18 |
| firmness | -1,23 | -1.52 | -0.67 |
| shine | -0,55 | 0.95 | 1.33 |
| shade of redness | -1,28 | 0.71 | 1.95 * |
| color of uniform quality | -1,56 | -0.76 | 0.70 |
| **FRESHNESS** | **-1,52** | **-0.09** | **0.09** |
| chain of temperature | -2,03 * | -1.68 | 0.56 |
| use of ice | -0,22 | 0.78 | 0.90 |
| chilling after slaughtering | 0,27 | 1.7 | 0.53 |
| distribution | -1,78 | -0.79 | 1.10 |
| storage | -0,52 | 0.22 | 0.81 |
| production | -0,04 | 0.27 | 0.33 |
| control by personnel | -2,45 ** | -3.27 *** | -0.42 |
| control by authorities | -1,09 | -0.28 | 0.77 |
| working methods | -0,83 | -0.05 | 0.67 |
| organizational culture | -0,18 | 1.58 | 1.29 |
| education | -1,82 * | -0.48 | 1.60 |
| attitudes | -1,52 | 2.01 * | 2.31 ** |
| **SAFETY** | **-1,53** | **-3.28\*\*\*** | **-2.26\*\*** |
| environmental risk | 0,37 | -1.40 | -1.7 |
| risk of food poisoning | -1,13 | -5.14 *** | -4.02 *** |
| antibiotics, hormones | -0,35 | 0.36 | 0.59 |
| radiation | -1,23 | -3.80 *** | -2.53 ** |
| colour additives | -1,06 | -0.95 | 0.18 |
| heavy metals | -1,94 * | -2.76 ** | -0.94 |
| **NUTRITION** | **-0,59** | **-3.35\*\*\*** | **-3.22\*\*\*** |
| vitamins and minerals | -0,31 | -4.28 *** | -4.57 *** |
| lightness | -1,97 * | -0.18 | 1.92 |
| blood pressure | 1,04 | -3.62 *** | -4.49 *** |
| coronary and vascular diseases | 1,68 | -0.67 | -3.50 *** |
| cholesterol | -0,18 | -2.24 ** | -1.73 |
| **SERVICE** | **2,35\*\*** | **4.50\*\*\*** | **2.32\*\*** |
| facilities of personnel | 4,18 *** | 4.12 *** | 0.04 |
| distribution | -0,69 | 1.16 | 2.14 ** |
| supportive marketing | -0,59 | 3.47 *** | 4.73 *** |
| responsiveness | 0,57 | 2.62 ** | 1.97 * |
| empathy | 1,05 | 2.58 ** | 1.36 |
| reliability | 1,39 | 2.31 ** | 1.10 |
| fish sortiment | 1,45 | 3.22 *** | 1.68 |
| other products | 1,25 | 1.63 | 0.69 |
| **IMAGE** | **-0,29** | **3.58\*\*\*** | **4.30\*\*\*** |
| price | 0,07 | 2.15 ** | 2.77 *** |
| package | 0,01 | 1.50 | 1.47 |
| brand name | 0,80 | 3.04 *** | 2.37 ** |
| product | -1,27 | 2.70 ** | 3.57 *** |
| opinions of other consumers | -1,09 | 3.07 *** | 4.48 *** |
| previous purchases | 0,06 | 3.29 *** | 4.56 *** |
| personal selling | 0,40 | 3.18 *** | 6.22 *** |
| advertising | -0,89 | 2.38 ** | 5.6 *** |
| public relations | 0,06 | 3.02 *** | 4.31 *** |
| sales promotion | -0,09 | 3.65 *** | 4.99 *** |
| producer image | 2,53 ** | 3.53 *** | 2.19 ** |
| store image | -0,90 | 2.82 *** | 3.44 *** |

## 4.      DISCUSSION

With the exception of freshness there were many considerable differences in the view of quality in different fish market sectors. Factors associated to raw material, production or marketing were preferred by wholesalers and retailers, as their daily task is to purchase, handle and sell fish. The representatives of the catering establishments emphasised factors which are associated to direct consuming: nutritional attributes of fish, enjoyment, benefit or threat of eating.

The retailers and the catering sector are both important customer segments for the wholesalers. However they operate in different field of activity, and obviously the needs of the retailers differ from the catering sector. In wholesalers point of view the quality should be those operations which satisfy the needs of different customer. Anyhow there was discrepancy between wholesalers' and customers' perceptions of the quality of rainbow trout. There might be numerous reasons for this discrepancy. The managers of wholesalers may think they know what customers want, but actually there is a gab between customers' expected quality and management perceptions of customers' exceptions (Parasumaran et al. 1985 and Zeithaml et al. 1988). On the other hand wholesalers may not recognise the difference between promised and expected delivery and actual delivery. One reason for the discrepancy could be that wholesalers emphasise their own field of activity in perception of quality. Because they operate close to the primary production, they consider high quality of raw material as one of the most important pre-condition for higher qualifications to be fulfilled later.      Nevertheless, without ignoring the importance of raw material or freshness, wholesalers should be aware of the discrepancy of perceptions of quality. Otherwise processing, delivery and particularly marketing operate ineffectively according to the needs of customers.

The data from catering sector was collected two years later than from other sectors. A serious food poisoning caused by spoiled fish occurred during this time lag and it received much attention in the media. Obviously catering sector rated the importance of safety and food poisoning in different exterior situations than wholesalers and retailers.

The importance of service to quality of rainbow trout is an interesting example of discrepancy of perception. Catering sector as well as wholesalers and retailers saw it from their own point of view. Inevitably service has an essential significance to rainbow trout delivery, purchasing and marketing. Retailers and especially catering establishments saw service relatively unimportant for rainbow trout quality, while wholesalers consider it as one of the main operations to satisfy customers needs. Retailers and catering establishments may be satisfied with actual level of service and they do not pay attention to it. It is also possible that retailers and catering establishments might simply consider that other factors are relatively more important. Another interesting example of discrepancy of perception was the importance of image. Catering sector saw that image is almost meaningless. Wholesalers and retailers, who market and sell fish constantly, might more concretely recognise the importance of image, while catering sector, as buyers, may not accept or realise its importance for the business.

It can be considered that structuring the total quality in the form of hierarchy provided a useful method to define the relevant factors, which affect to the quality of fresh rainbow trout fillets. The method also enabled to identify the similarities and differencies in quality perceptions in Finnish fish trade chain.

This study indicates that there may be major discrepances in the quality perceptions of fish sellers and buyers.  In these circumstances quality improvements carried out only in the company level may be ineffective, if the co-operation between the actors is not extended from the daily selling and purchasing operations to collective quality improvement activities.

For the time being representatives of fish trade chain, authorities and researchers are preparing a national fish quality strategy, which represents a new way to intensify the co-operation in the trade chain. The overall goal of the strategy is to improve the competitiviness of Finnish fish business by continuous improvements in the quality of companies' operations and fish products. Vertical integration of fish trade chain or collaborative quality projects  may offer efficient means to develop fish business. The reasearch method used in this study may be an useful tool to evaluate where collaborative actions and quality improvements are most needed.

## 5.   ACKNOWLEDGEMENTS

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**Appendix A.**

The rating technique used in this study is illustrated in figure 3 below. The decision objective (overall goal) in the example is divided into three main criteria, and one of those is divided into two levels of subcriteria. The main criterion 3 is further divided into subcriteria 3.1 and 3.2. The criterion 3.1 consists of subcriteria 3.1.1 and 3.1.2. The decision maker  (in our case a person interviewed) gives a value between 0 and 1 to criteria, according to the relative importance when compared with the other criteria at the same level. Those weights are called local weights. The sum of the local weights at the same level and under the same higher criterion, must be 1.

The global weight of a criterion is calculated by multiplying  it's own local weight with the local weights of the criteria preceding it in the hierarchy. For example, the global weight of subcriterion 3.1.2 is calculated by multiplying the local weight of criterion 3 with that of subcriterion 3.1, which is further multiplied with the local weight of criterion 3.1.2 itself (0.3*0.4*0.8=0.096). The weight of overall criterion is decomposed to criteria at the last level of hierarchy. The last level components n the example are criteria 1 and 2, subcriterion 3.2 and criteria 3.1.1 and 3.1.2. Thus the sum of the global weights of those criteria is 1 (0.4+0.3+0.18+0.024+0.096=1).
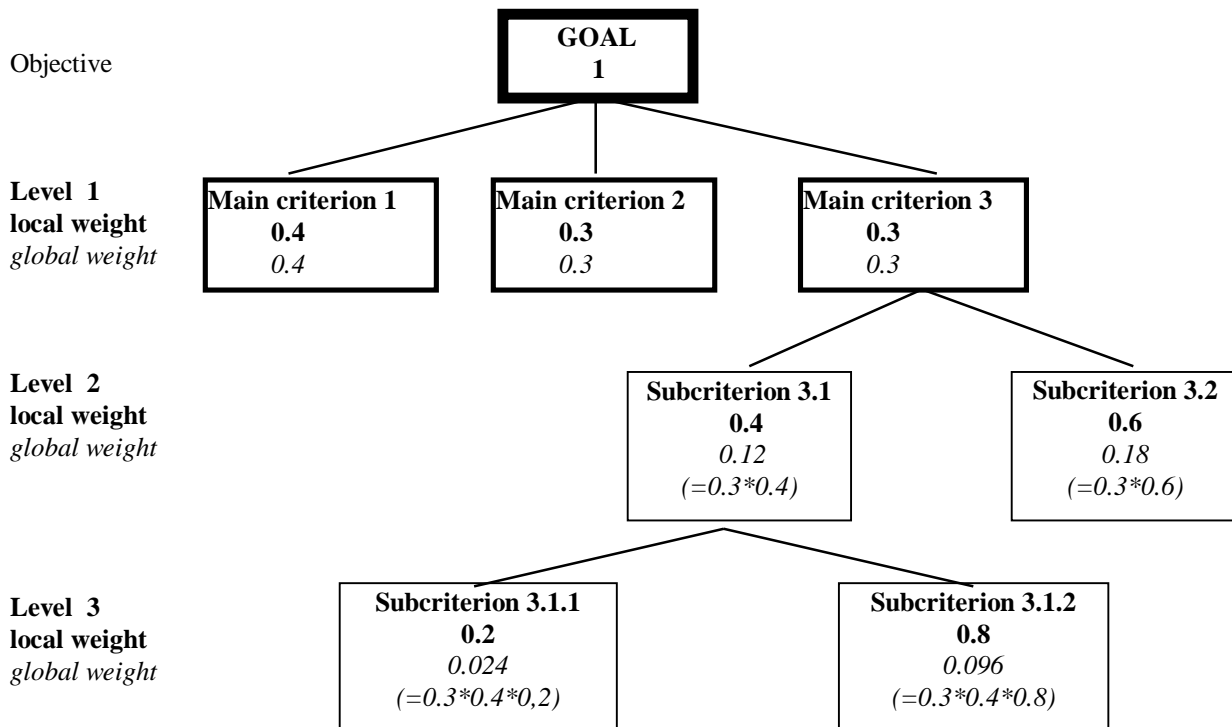
**Figure 3**. An example of a hierarchy and the rating system

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**Appendix B.**

The contents of criteria in model of the total quality of rainbow trout fillet.

| ELEMENT | CONTENT |
|---|---|
|  |  |
| **RAWMATERIAL** | whole, unprocessed rainbow trout |
| Cultivation environment | effects of the growth environment (water quality) to the product |
| Size | weight of fish |
| Sex, maturity | female/male, mature/immature |
| Fat content | fat content of tissue in the fish |
| **SENSORY QUALITIES** | qualities based on observation |
| Appearance | observed with sight |
| flawnessess | no cleaning rests, bones, parasites etc. |
| attractiveness | delicious taste, appearance which attracts a consumer to buy |
| fillingness | features making preparing easier |
| colour | a colour specific for the fish species |
| shine | shine of the surface of the fillet |
| shade of redness | colour of rainbow trout fillet measured with Roche's grading |
| colour of uniform quality | colour uniformly distributed in a single fillet or in the whole batch |
| Odour | observed with sense of smell |
| Taste | observed with taste |
| juiciness | amount of water freed from the product in the mouth during chewing |
| mouth experience | easy-to-eat, amount of force needed to chew the fish |
| aroma | a natural taste of a product |
| Texture | observed with mechanical senses and with sense of touch |
| elasticity | the ability of a product to return to to its original shape after squeezed lightly |
| moisture | the amount of freed water when squeezed |
| firmness | the resistance of fish meat when it is squeezed against roof of the mouth |
| **FRESHNESS** | the effect of production and distribution time on the quality of fish |
| Conservation | conditions in the store-house (temperature and moisture) |
| chain of temperature | maintenace of temperatures below $3^0$C during the whole production process |
| use of ice | use of ice to keep fish cold and wet |
| chilling after slaughtering | rapid chilling of fish to 0-$3^0$C directly after catch, slaughtering and cutting |
| Hygiene | procedures needed to prevent bacterial contamination of the product |
| functional surroundings | processing environmet and its fitness for use |
| distribution | the means by which fish is taken from the wholesaler to retailer |
| storage | time of storage, storage during distribution |
| production | production processes |
| control of hygiene | control of hygiene with measurements and check-ups |
| control by personnel | HACCP (Hazard Analysis of Critical Control Points), activities performed by company's own personnel in order to prevent bacterial contamination |
| control by authorities | system of control by authorized people outside the company |
| personnel | production personnel's affect on hygiene |
| working methods | working standards and systems in the company |
| organizational culture | common adopted policy in the company affecting the activities in the company |
| education | the effect that knowledge has on the behaviour of personnel |
| attitudes | a fixed way to an individual to react |
| **SAFETY** | a safe and reliable product |
| Harmful substances | small particles non-natural to a fish |
| antibiotics, hormones | the risk caused by modification of fish |
| radiation | radioactivity of fish |
| colour additives | substances in fodder affecting the colour of fish |
| heavy metals | heavy metals accumulated in fish |
| Environmental risks | harmful effects of fish farming to water systems, fish diseases |
| Risk of food poisoning | risk of food poisoning and contamination of food supply |
| **NUTRITION** | the effects that nutrition has on human body |
| Vitamins and minerals | positive effects of vitamins and minerals |
| Lightness | low energy content |
| Health effects | health improving effects |

| blood pressure | blood pressure lowering effects |
|---|---|
| coronary and vascular diseases | coronary and vascular diseases preventing effects |
| cholesterol | cholestrol lowering effects |
| **SERVICE** | service during sales processes |
| facilities of personnel | effect of personal contact during a sales process |
| supportive services | activities improving service (marketing and distribution support) |
| distribution | willingness to additional deliveries |
| supportive marketing | recipes, sales consultants, marketing material, consumer guidance, brochures |
| functional principles | content and smoothness of daily processes |
| responsiveness | willingness to improve service |
| empathy | ability to understand customers |
| reliability | reliability of delivery, deliveries in time, correct invoicing |
| range of products | product sortiment of the wholesaler |
| range of fish products | how many different fish products are on sale |
| range of other products | how many other products are on sale |
| **IMAGE** | unconscious features associated with the product or sales processes |
| product image | image of the physical product |
| price | the price of the product |
| packaging | the packaging of the product |
| brand name | the brand or symbol of company's product |
| product | the features of the physical product |
| purchasing surroundings | factors in purchasing surroundings affecting purchase decision |
| marketing | marketing processes and advertising |
| personal selling | personal sale activities, for example selling on the phone, visiting the customer |
| advertising | advertising in the newspapers and television |
| public relations | creating positive attitudes towards company's business in the long-term |
| sales promotion | activities supporting and intensifiyng selling |
| opinions of other consumers | other consumers' opinions of the product |
| previous purchases | previous positive or negative purchase experiences |
| company image | image associated with the company |
| producer image | consumer's image of the producer |
| store image | consumer's image of the store |