The effects of feed composition on the sensory quality of organic rainbow trout during ice storage

Ditte Green-Petersen, Grethe Hyldig, Charlotte Jacobsen, Caroline Baron and Henrik Hauch Nielsen

Abstract

The focus of this work was to study which effects the type of protein and lipid source in the feed for organic Rainbow trout influences had on the sensory quality of final product. Two and four different protein and lipid sources were used in the experiment respectively. The protein sources were fishmeal and a mixture of protein from organic vegetable, while the lipid sources were fish oil and organic oil from linseed, sunflower, rapeseed and grape seed. Sensory analysis was performed after 3, 5, 7 and 14 days of storage in ice. The results showed that both protein and lipid source in the feed can influence sensory characteristics of the trout. After 3 and 7 days of storage in ice differences in the sensory characteristics between rainbow trout's which have had different lipid sources in the feed were observed. While a difference between the trout fed with different protein sources were observed after 14 days of storage, indicating that vegetable protein in the feed increases the self-life of organic rainbow trout.

Foders betydning for sensorisk kvalitet af økologisk regnbue ørreder

Resume

Formålet med dette forsøg var at undersøge betydningen af forskellige protein og fedt kilder i foderet til økologiske regnbue ørreder for den sensoriske kvalitet af det endelige produkt. Henholdsvis to og fire forskellige protein og fedt kilder blev anvendt i forsøget. Protein kilderne var fiskemel og en blanding af protein fra forskellige økologiske vegetabilier, imens fedt kilderne i foderet var fra fiskeolie og økologisk: hørfrø, solsikke, raps og vindruekerne olie. Sensorisk analyse blev udført efter henholdsvis 3, 5, 7 og 14

dags lagring i is. Resultaterne viser at både protein og fedt kilden i foderet kan påvirke de sensoriske egenskaber of regnbue ørreder. Efter 3 og 7 dags lagring i is blev der fundet en forskel mellem de sensoriske egenskaber af regnbue ørreder som havde fået forskellige fedt kilder i foderet. Imens der efter 14 dags lagring i is blev fundet en forskel mellem ørrederne der havde fået forskellige protein kilderne i fodret, som indikere at de vegetabilske protein i fodret øger holdbarhed of regnbue ørreder.

Introduction

There is in Denmark an increasing interest in producing organic farmed Rainbow trout (*Oncohynchus mykiss*). Therefore there is also increasing interest in organic feed which can be used to party replace fish meal and fish oil in the feed.

In this experiment the main aim was to find out how replacement of fish oil with different vegetable organic oils in the feed for Rainbow trout (*Oncohynchus mykiss*) effects the sensory characteristics of finial product after different length of storage times in ice. Furthermore it was also of interest to study the effect replacing fish meal with a mixture of protein from organic vegetables.

Material and Methods

Fish and feeding experiment

The Rainbow trout (*O. mykiss*) used in the experiment had a size of 50g before the feeding trail. The experiment includes six different feed types. The control have had traditional feed for organic rainbow trout containing mainly fish meal as protein sours and fish oil as lipid source. All other groups have had a mixture of vegetable organic protein sources containing horse beans, peas, rapeseed and wheat as protein source. However, these groups have had different vegetable organic oils (linseed, sunflower, rapeseed or grape seed oil) or fish oil as lipid source in the feed. All feed mixtures had a lipid content of 28% and a protein content of 48%.

The fish were slaughter and frozen at -40°C until the sensory experiment was performed.

Sensory profiling

The fish were place at 2°C for 6 hours for thawing. After thawing the fish were stored in ice (0°C) for 3, 5, 7 and 14 days respectively before sensory profiling was performed.

The fish were after the storage period filleted and one piece was cut out of each fillet (approximately size 5×3×0.7cm). The samples were before serving heat-treated in a convention oven at 100°C until the core temperature had reached 70°C. Samples were cooked in their own juice without any additives. The heat treatment was performed in porcelain trays with lids and the samples were afterwards served to the assessors in these porcelain trays. Each porcelain tray was marked with a three-digit code on the lid. The samples were served in random order with the skin side facing downwards. All codes were evaluated in replicates.

The sensory evaluations were performed during a three weeks period of time. In each week three sessions were held, and in each session the assessors evaluated three or four samples in replicates.

The sensory panel consisted of 11 assessors. Between 7 and 11 assessors participated on each test day. All assessors were selected, tested, and trained in descriptive analysis of Rainbow trout according to standards (ISO 11035; ISO 8586-1; NMKL 21). The sensory attributes were for appearance; colour and discolour, for odour; earthy, mushroom, cooked potatoes, sourish, warm milk, fishy, rancid, sour and off-odour, for flavour; sweet, fresh fish oil, green, chicken , rancid, sour, fishy and off-flavour, and for texture; flaky, firm, juicy, stringy and oily.Each descriptor was evaluated on an unstructured 15-cm scale anchored 1.5 cm from both ends. The assessors were trained in using the descriptors during four training sessions before the sensory study was performed. In the training sessions, the assessors tasted samples similar to those used

in the study. Each training session lasted 2 to 3 h. During the training, the assessors together with the panel leader evaluated the reference sample and determined the intensity for each descriptor.

The evaluations were performed according to ISO 8589 (1988) in separate booths under normal daylight. The assessors used water and flat bread to clean the mouth between samples. Data were collected using a computer system (FIZZ Network version 2.0, Biosystems, Couternonm, France).

Data analysis

The results from the sensory profiling were corrected for level effects by the method of Thybo and Martens (2000). Principal Component Analysis (PCA) was used to study multivariate differences between sensory profiles of the trout which had differed feed. Before this analysis, PCA was used to identify outliers between the evaluations of each fish. Outliers were identified as evaluations placed isolated in the score plot. All outliers were removed from the dataset.

Correction for level effects and PCA was performed using the Unscrambler 9.1 (CAMO, Trondheim, Norway).

Results

Chance during storage in ice

When comparing all storage times and feeds it is clear that the storage time in ice have important influence on the sensory characteristics of the trout. The samples with the longest storage time (14 days) has a high intensity of the following sensory characteristics off-odour, off-flavour, sour, rancid, fish odour and flavour, discoloured, colour, fluid extraction, firm and stingy texture. While trout with a short storage time (3 days) has a high intensity of juicy and flaky texture, fresh fish oil, sweet and green flavour. This resulted was expected and in agreement with earlier studies.

Differences between feeds after 3 days of storage in ice

The two most different samples after 3 days of storage in ice are the trout which have had grape seed oil or linseed oil in the feed. The trout which have had linseed oil in the feed seems to have a sensory profile which is very similar to the sensory profile of the trout which have had the fish oil in the feed and the control feed. The trout which have had the feed with linseed oil, fish oil and the control feed have a sensory profile which is characterised by a high intensity firm, stringy, juicy, oily, warm milk, sourish and cooked potatoes odour, green and fresh fish oil flavour. On the other hand the trout which have had grape seed oil in the feed have lower intensity of these characteristics while it has a flaky texture and a high intensity of chicken flavour.

Trout fed with grape seed oil is not only clearly different from the trout fed with linseed oil or fish oil and the trout fed control feed, but also the trout which have had rapeseed oil in the feed. There is also a sensory difference between the trout which have had sunflower or rapeseed oil in the feed compared to the trout which have linseed oil in the feed.

The differences in sensory profile between the rainbow trout which have had different lipids in the feed might be explained by differences in fatty acids compositions. The fatty acid profile of linseed oil have some characteristics in conmen with the fatty acid profile of fish oil since both have a high content of omega three fatty acids and a low content of omega six fatty acids compared to both grape seed, rapeseed and sunflower oil.

Difference between feeds after 5 and 7 days of storage in ice

The differences which is seen in the texture between the trout fed with fish oil, linseed oil or rapeseed oil in the feed compared with trout fed with grape seed oil in the feed after 3 days of storage is not seen when the trout has been stored for a longer period of time (5, 7 and 14 days of storage). The reason for this is probably related to the ice storage, since it has been showed in other studies that the texture chances during storage in ice. Theses chances includes that hardness (Andersen et al. 1997; Azam et al. 1989; Færgemand et al 1995) and juiciness (Sveinsdottir et al. 2003; Waagbø et al 1993) decrease.

After 5 days of storage in ice all the trout seems rather similar in sensory profile. However after 7 days in ice some differences is appearing. The trout which have had rapeseed oil or grape seed oil in the feed generally has more neutral flavour and odour profile for instance with low intensity of mushroom odour, cooked potatoes odour, fresh fish oil flavour and sweet flavour. Furthermore the texture also is less flaky, firm, juicy, stringy and oily compared to the other samples. This indicates that trout fed with rapeseed or grape seed oil in the feed earlier during storage gets a more neutral odour and flavour plus a reduced quality of texture compared to trout which have had fish, linseed and sunflower oil in the feed.

After 14 days of storage in ice

Between the trout's which have been stored in ice 14 days, one sample is very different from the rest of the trout´s. This is the trout which have had the control feed (which contains fish meal and fish oil). Although it should be outlined that there is no significant differences but only a tendency to a difference between the control trout and the trout fed with grape seed oil in the feed.

The reason for the special sensory profile of the control code after 14 days of storage in ice is related to high intention of several negative flavour and odour descriptors. The most important of these flavour and odour descriptors is rancid. This shows that the control code is more tainted than the other codes after 14 days of storage in ice and therefore it is seen that the self-life is increased by feeding the fish with vegetable protein compared to fish meal.

Conclusion

Different vegetable oils in the feed for trout influence the sensory profile in different ways. The use of grape seed oil in the feed results in a different flavour and texture profile in the beginning of an ice storage period compared to the use of fish oil in the feed. While using linseed oil in the feed results in a sensory profile that is much more

similar to the profile obtained when using fish oil in the feed. As expected all trout in the experiment goes through a development during the ice storage. In the beginning of the storage period the sensory profile is dominated by positive sensory descriptors, then the profile get's more neutral, and finally the negative sensory descriptors becomes dominating. However the results shows the development from a positive to a more neutral profile is influence by the type vegetable oil used in the feed. Since trout which have had grape seed oil or rapeseed oil has a more neutral sensory profile compared to the other feed types after 7 days of storage in ice.

Finally the results also show that the protein type in the feed influences the shelf-life of the trout during storage in ice. Vegetable protein in the feed increases the shelf-life compared to fishmeal.

References

Andersen, U.B., Thomassen, M.S. and Rørå, A.M.B. 1997. Texture properies of farmed Rainbow trout (*Oncorhynchus mykiss*): Effects of diet, muscle, fat, content and time of storage on ice. Journal of the Science of Food and Agriculture 74, 347-353.

Azam, K., Mackie, I.M. and Smith, J. 1989. The effect of slaughter method on the quality of rainbow trout (*Salmo gairdneri*) during storage on ice. International Journal of Food Science and Technology 24, 69-79.

Færgemand, J., Rønsholdt, B., Alsted, N. and Børresen, T. 1995. Fillet texture of Rainbow trout as affected by feeding strategy, slaughtering procedure and storage post mortem. Water Science and Technology 31(10), 225-231.

ISO 1994. ISO standards 11035. Sensory analysis – Identification and selection of descriptors for Establishing a sensory profile by a multidimensional approach, 1 st Ed., International Standard organization, Geneva, Switzerland.

ISO. 1993. ISO standards 8586-1. Sensory analysis – General guidance for the selection, training and monitoring of assessors. Part 1. Selected assessors. International standard. 1. Edition.

ISO. 1988. ISO standards 8589. Sensory Analysis – General guidance for design of test rooms. International standard. 1. Edition.

NMKL Procedure No. 21. Guide for sensory analysis of fish and shellfish. Hyldig, G., Carlehög, M., Martinsdóttir, E., Sveinsdóttir, K. and Lilleberg, L. 2008. Available: http://www.nmkl.org/Engelsk/index.htm

Sveinsdottir, K., Hyldig, G, Martinsdottir, E, Jørgensen, B and Kristberg, K. 2003. Quality index method (QIM) scheme developed for farmed Atlantic salmon (*Salmo salar*). Food Quality and Preference 14(3), 237-245.

Thybo, A.K. and Martens, M. 2000. Analysis of sensory assessors in texture profiling of potatoes by multivariate modelling. Food Quality and Preference 11, 283-288.

Waagbø, R., Sandnes, K., Torrissin, O.J., Sandvin, A. and Lie, Ø. 1993. Chemical and sensory evaluation of fillets from Atlantic slamon (*Salmo salar*) fed three levels of N-3 polyunsaturated fatty acids at two levels of vitamin E. Food Chemistry 46, 361-366.