The effects of food container depth and coverage on the quality of superchilled rainbow trout

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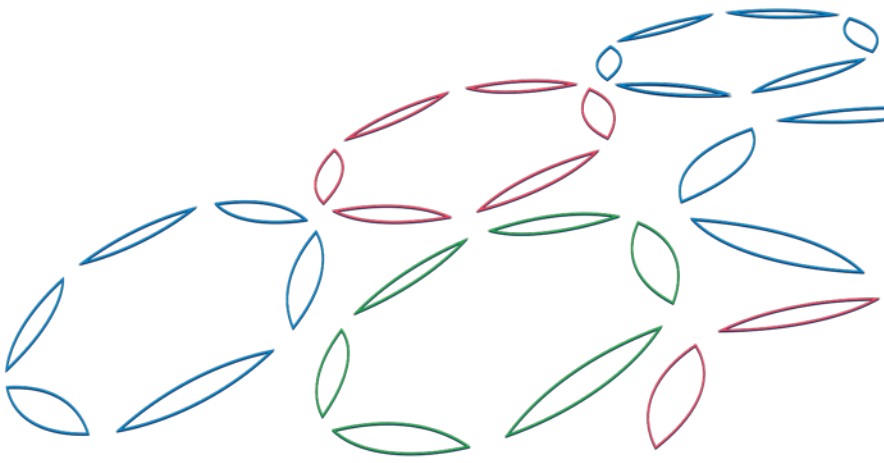

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Report summary

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Titill / Title	**The effects of food container depth and coverage on the quality of superchilled rainbow trout /** Áhrif dýptar einangraðra kera á gæði ofurkælds regnbogasilungs		
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Ágrip á íslensku:	Ferskur eldisfiskur er almennt slægður og pakkað í frauðplastkassa með ís fyrir útflutning í kæligámum. Í ljósi þess að mikil þróun hefur átt sér stað hvað varðar ofurkælingu og jákvæð áhrif hennar á gæði fiskafurða, þá hafa aðrar hagkvæmari og umhverfisvænni pökkunarlausnir verið skoðaðar, þar á meðal einangruð matvælaker. Meginmarkmið verkefnisins var að meta áhrif mismunandi pökkunaraðferða á gæði fersks regnbogasilungs. Slægðum fisk með haus var pakkað í frauðplastkassa og einangruð ker af mismunandi dýpt (29-60 cm). Auk samanburðar á misdjúpum kerum, þá voru mismunandi útfærslur við lokun á kerum einnig skoðaðar. Fylgst var með tilraunafiskum efst og neðst í hverju keri. Kerin voru geymd í hitastýrðu umhverfi við um -1 °C og gerðar mælingar eftir 8 og 13 daga frá pökkun. Sá fiskur sem pakkað var í frauðplastkassa var ýmist ofurkældur fyrir pökkun eða kældur á hefðbundinn hátt með ís. Það var gert til að meta áhrif ofurkælingar á ferskan regnbogasilung. Til að meta gæði regnbogasilungsins var fylgst með örveruvexti, áferð og losi í flökum. Niðurstöðurnar sýndu að þær pökkunarlausnir sem skoðaðar voru í verkefninu höfðu tiltölulega lítil áhrif á heildarörverufjölda, en ekki reyndist marktækur munur á milli tilraunahópa við lok geymslutímabilsins. Almennt var lítill sem enginn munur á milli hópa m.t.t. áferðar og loss í flökum. Aftur á móti sýndu niðurstöðurnar að nauðsynlegt er að loka kerunum, en tegund loks hafði ekki marktæk áhrif. Ofurkæling fyrir pökkun hafði marktæk áhrif á los. Fiskur sem var kældur á hefðbundinn hátt og pakkað í frauðplastkassa með ís hafði marktækt meira los samanborið við þegar hann var ofurkældur og pakkað í ker eða frauðplastkassa án íss. Niðurstöðurnar sýna að ekki er marktækur munur á milli frauðplastkassa og kera af mismunandi dýpt miðað við þær gæðabreytur sem skoðaðar voru í þessu verkefni. Þær gefa því til kynna að flutningur á ofurkældum regnbogasilungi í kerum er raunhæfur möguleiki m.t.t. stöðuguleika hráefnisins og afurðargæða.		
Lykilorð á íslensku:	*Gæði, regnbogasilungur, ofurkæling, matvælaker, keradýpt*		

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Summary in English:	The overall aim of the study was to explore the effects of different packaging solutions on the quality of fresh rainbow trout. Different packaging methods included expanded polystyrene boxes (EPS), insulated food containers of 29 to 60 cm depth with various combination of covers. Each container was split up into two groups, top- and bottom layer. Both fish chilled on ice and superchilled fish were considered. Microbial growth and sensory characteristics (fillet gaping, softness and elasticity) were used to evaluate the quality of the rainbow trout fillets after 8 and 13 days of storage at around -1 °C. The different packaging solutions had no effects on the microbial quality of the fish. Moreover, no listeria activity was detected. Sensory evaluation showed minor differences between containers of different depths and/or EPS boxes, as well as between top and bottom layers. However, the presence of cover proved to be of great importance, but the type of cover turned out to be not relevant. The effects of superchilling before packaging on fillet gaping was evident in present study since fish packed in EPS box with ice resulted in more gaping than superchilled fish packed in EPS boxes and/or containers without ice.
English keywords:	*Quality, rainbow trout, superchilling, food containers, container depth*

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1 Introduction

Fresh farmed fish is traditionally packed gutted with head in expanded polystyrene (EPS) boxes with ice before being transported via sea or land in refrigerated shipping containers. Following the development of superchilling technologies and increased knowledge on the effects of superchilling on fish quality, other more economical and environmentally friendly packaging options have been suggested and tested. Both Margeirsson *et al.* (2017) and Þórðarson *et al.* (2017) concluded that superchilling increases the choice of packaging types for fresh fish. Moreover, Margeirsson *et al.* (2017) suggested that 29-40 cm deep insulated containers are a viable option for transport of whole, superchilled rainbow trout without ice in the containers.

Transportation of fresh fish from Iceland towards US and Europe via sea freight can take up to seven days, leaving the products vulnerable against any temperature fluctuations which can lead to lower quality and reduced shelf-life (Mai *et al*., 2011). Using special packaging solutions, such as insulated containers (often referred to as fish containers or fish tubs), along with applying superchilling before packing might result in a more secure cold chain for fresh fish products and hence decreased waste. Extended shelf-life of fresh fish products will both provide higher value for the primary producer as well as meeting the costumer's demand for high quality products. Therefore, finding the most appropriate packaging solution is of vital importance.

The aim of present project was to study the effects of different packaging methods on the quality of fresh rainbow trout. Packaging solutions included insulated containers of 29 to 60 cm depths and EPS boxes. Both fish chilled on ice and superchilled fish were considered. Microbial growth, gaping and other sensory characteristics were used as parameters to evaluate the fish quality.

2 Materials and methods

2.1 Raw material and experimental design

Commercial available rainbow trout (*Oncorhynchus mykiss*) were used in the study. After slaughtering, gutting and bleeding, the fish was stored in slurry ice (-1 °C to 0 °C) for one day before packaging. The fish was packed superchilled and/or traditionally chilled in 250 L, 380 L and 460 L insulated containers as well as in EPS boxes. The containers were then either covered with plastic bags, lids or left uncovered. More detailed description of the experimental groups is summarized in Table 1 and Figure 1 to Figure 5. After packaging one day post slaughtering, the containers and EPS boxes were transported by land to the research facilities at Matís in Reykjavík. The containers and the EPS boxes arrived to Matís three and six days post slaughtering, respectively, where they were to be stored at around -1.4 °C until the end of the experiment.

Table 1. Description of experimental groups.

Experimental group	**A** Container 380 L	**B** Container 460 L	**C** Container 460 L	**D** Container 250 L	**E** Container 250 L	**F** Container 250 L	**G** EPS 23 kg	**H** EPS 23 kg
Chilling before packaging	Super-chilling	Super-chilling	Super-chilling	Super-chilling	Super-chilling	Super-chilling	Traditional chilling with ice	Super-chilling
Cover	Plastic bag	Plastic bag	Lid	Plastic bag	No cover	Thin lid	Lid	Lid
Additional description	-	-	Grid in bottom of container	-	-	-	Drain holes in bottom	Absorbent pad at bottom, no drain holes
Fish weight (kg/unit)	279	318	263	187	169	169	21	21
Pack. depth (cm)	60	40	40	29	29	29	17	17
No. of containers	1	1	1	1	1	1	4	4

The EPS boxes and the containers used in the study were manufactured by Tempra ltd. (Hafnarfjörður, Iceland) and Sæplast Iceland ltd. (Dalvík, Iceland), respectively.

Figure 1. 380 L container with plastic cover (group A) to the left and 460 L container before adding the plastic cover (group B) to the right.

Figure 2. 460 L container in experimental group C with lid (to the left) and drain grid in the bottom of the container (to the right).

Figure 3. 250 L container to the right with plastic cover (group D); and 250 L container without plastic cover or lid (group E).

Figure 4. 250 L container with thin lid (group F).

Figure 5. EPS boxes with traditional chilled fish (group G, to the left) and superchilled fish (group H, to the right). Both EPS experimental groups had lids.

The experimental groups were evaluated 8 and 13 days post packaging. On day 8, the fish from the top of each container (n = 12) were collected, filleted and evaluated. On day 13, fish from both the bottom and top of each container were collected as well as from the EPS boxes. Overview of the sampling and parameters evaluated on day 8 and day 13 is summarized in Table 2 and Table 3, respectively.

Table 2. Sampling of the experimental groups and evaluated parameters on day 8 post packaging. Fish was collected from surface (top) and bottom of each container. Description of different experimental groups can be viewed in Table 1.

Experimental group	Fish position	Listeria	TVC	Gaping	Softness	Elasticity
A	Top	-	-	x	-	x
	Bottom	-	-	-	-	-
B	Top	-	-	-	-	-
	Bottom	-	-	-	-	-
C	Top	-	x	x	-	x
	Bottom	-	x	-	-	-
D	Top	x	x	x	-	x
	Bottom	x	x	-	-	-
E	Top	-	-	-	-	-
	Bottom	-	-	-	-	-
F	Top	-	x	x	-	x
	Bottom	-	-	-	-	-
G	Top	x	x	x	-	x
	-	-	-	-	-	-
H	Top	x	x	x	-	x
	-	-	-	-	-	x

Table 3. Sampling of the experimental groups and evaluated parameters on day 13 post packaging. Fish was collected from surface (top) and bottom of each container. Description of different experimental groups can be viewed in Table 1.

Experimental group	Fish position	Listeria	TVC	Gaping	Softness	Elasticity
A	Top	-	x	x	x	x
	Bottom	-	x	x	x	x
B	Top	-	x	x	x	x
	Bottom	-	x	x	x	x
C	Top	-	x	x	x	x
	Bottom	-	x	x	x	x
D	Top	-	x	x	x	x
	Bottom	-	x	x	x	x
E	Top	-	-	-	-	-
	Bottom	-	-	-	-	-
F	Top	-	x	x	x	x
	Bottom	-	-	x	x	x
G	Top	-	x	x	x	x
	-	-	-	-	-	-
H	Top	-	x	x	x	x
	-	-	-	-	-	-

Figure 6. Filleting of rainbow trout prior to quality evaluation.

2.2 Temperature monitoring

The temperature of the experimental groups, as well as ambient air temperature, was monitored throughout the storage time with TidbiT (UTBI-001) temperature loggers from Onset (Bourne, MA, USA). The temperature loggers were at placed at various positions in the coolers: at the top-middle of the containers, bottom of the coolers and on the corners of the containers. This setup allowed to map the fluctuation of temperature at various locations in the cooler. The measurement range of the Onset temperature loggers is -20 to 70 °C, the resolution is 0.02 °C and the accuracy is ±0.2 °C at 0 to 50 °C.

Ibutton temperature loggers were used to monitor the fish temperature. These loggers have an accuracy of ±0.5 °C, a resolution of 0.0625 °C and an operating range of -40 to 85 °C. The diameter is 17 mm and the thickness is 6 mm. These temperature loggers were placed inside the rainbow trout muscle, at around 15 mm depth.

2.3 Microbial evaluation

Total viable count (TVC) was performed on fillets from fish collected on day 8 from the top of each container and on day 13 from the top and bottom of each container as well as from the

EPS boxes. The muscle near the gills of the rainbow trout was chosen for TVC evaluation due to the higher risk of contamination. The TVC was determined according to the Nordic Committee on Food Analysis (NMKL) method (NMKL, 2006). *Listeria monocytogenes* activity was searched on the skin of the fish on day 8 according to the NMKL method (NMKL, 2010).

2.4 Sensory evaluation

Gaping, softness and elasticity of fish fillets was evaluated on day 8 and day 13 post packaging, using "*Guide for evaluating fillets texture in Atlantic Salmon*" (Erikson, 2009), shown in Appendix. Gaping was evaluated on five point scale from 0 to 5 with photos of salmon representing each score (Appendix). Based on the photos provided, the gaping grading scale was constructed and is summarized in Table 4. Softness was evaluated on a thee point scale from 0 to 2 where 0 = firm fillet and 2 = soft fillet. Finally, elasticity was evaluated on three point scale from 0 to 2 where 0 = elastic and 2 = inelastic. More detailed description can be viewed in Appendix.

Table 4. Grading scale for evaluation of gaping in salmon fillets.

Description	Grade
No visible gaps	0
Minor gaping, less than 10%	1
Minor gaping, less than 20% or 1-3 longitudinal cracks	2
Minor gaping in one area (20%) or >3 longitudinal cracks	3
Some gaping, 25-75% of the fillet	4
Deep cracks or gaping in more than 75% of the fillet	5

The gaping evaluation (n=18-20 for each group) was performed by 4-5 trained panellists under a white light and on a white table. Each fillet was coded with a three-digit number and the fillets were evaluated in a randomized order. Before the gaping analysis, the fillets were stored at approximately 0 °C for 1-2 hours after filleting.

Both softness and elasticity were evaluated by one panellist. On day 8, the fillets were evaluated immediately after filleting followed by gaping evaluation. However, on day 13, the gaping was evaluated first followed by evaluation of softness and elasticity. The fillets were not evaluated by the same panellist on both sampling days.

Figure 7. Randomized fillets before the sensory evaluation.

2.5 Statistical analysis

Analysis of variance (glm – general linear model) was carried out on scores for gaping in the statistical program NCSS 2000 (NCSS, Utah, USA), where correction was made for different use of the scale by the panellists. One way ANOVA was used to analyse data for elasticity and softness. Comparison of data with respect to treatments was performed using the Duncan's multiple comparison test. The significance level was set at 5%.

3 Results

3.1 Temperature monitoring and raw material

The average ambient temperature throughout the storage period is presented on Figure 8. The average ambient temperature during the whole storage time was 0.0 °C ±2.1 °C. The main deviations from the planned ambient temperature of -1 °C were experienced during the ~ 450 km transport from the processing plant in Westfjords to Reykjavík on the first day from packing in addition to a short time period during sampling on day 8.

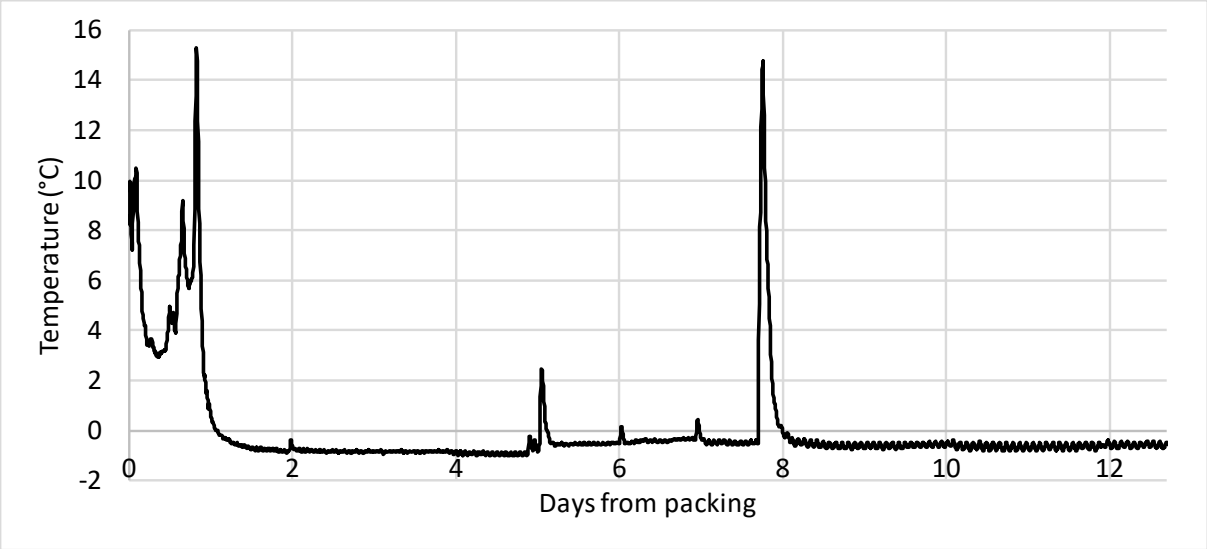

Figure 8. Ambient temperature from packing throughout the storage period.

More importantly, the fish temperature for most groups is presented in Figure 9 and their averages and standard deviations in Table 5. The results show that the fish temperature was very stable throughout the storage time, partly relying on the fact that the fish was superchilled (partially-frozen) before packing. The temperature mapping of the other groups failed but since groups B, C and H also contained superchilled fish, the fish temperature in these groups was very likely similar to the others. Group G with fish chilled in ice in EPS boxes was very likely around -0.5 to 1 °C during most of the storage time as was experienced in a similar study by Margeirsson *et al*. (2017).

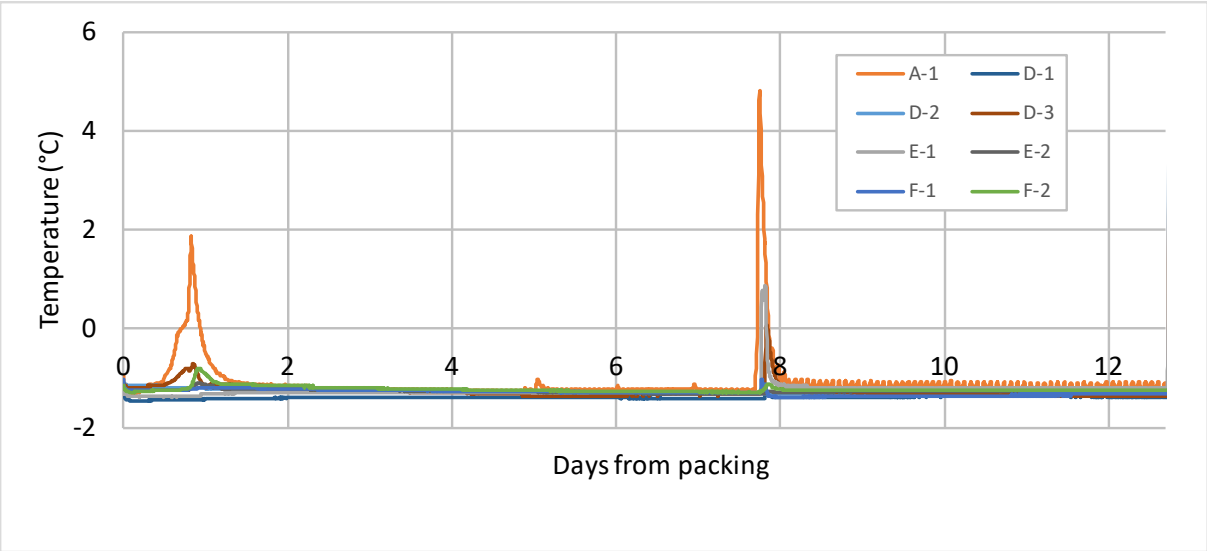

Figure 9. Fish temperature profiles at top of groups A, D, E and F from packing until the end of the experiment on day 13.

Table 5. Average temperature and standard deviation of groups A, D, E and F during the whole storage time.

Group	Average (°C)	Standard deviation
A	-1.1	0.5
D	-1.3	0.6
E	-1.2	0.2
F	-1.2	0.1

3.2 Sensory evaluation

After filleting 8 and 13 days post packaging, a sensory evaluation of the fillets was performed. The fillet gaping and elasticity were evaluated on both sampling days, while the fillet softness was only evaluated on day 13 post packaging. Moreover, on day 8 only fish from the surface (top) of the containers were evaluated, while on day 13 fish from both surface and bottom of the containers were evaluated. The packaging method applied for group E, where no cover was used on the container, was considered not applicable due to extreme dryness and toughness of the fish skin. The data collected for group E were therefore not included in present report.

Low scores for fillet gaping were observed for all experimental groups on day 8, with average values ranging from 0.6 to 1.4 which can be interpreted as “almost no gaping” to “slight gaping” (Table 6). The results indicated that fish packed in EPS boxes with ice (group G) had

more fillet gaping compared to fish in all the other experimental groups on both sampling days. Fish stored in 460 L container with lid and grid in the bottom (group C) had the lowest fillet gaping 8 days post packaging and were significantly lower compared to fish stored 380 L container with plastic cover (group A) and 250 L container covered with thin lid (group F). Apart from the fish packed in EPS boxes with ice, no differences in fillet gaping were observed between other experimental groups on day 13.

Table 6. Gaping in fillets 8 and 13 days post packaging and storage at -1.4 °C. On day 8 only fish from the surface (top) of the containers were evaluated (n=17-20), while on day 13 fish from both top and bottom of the containers were evaluated (n=9-10). Different letter within column indicate significant statistical difference between groups (p<0.05). Description of different experimental groups can be viewed in Table 1. *Average fillet gaping score from fish collected both from the surface (top) and bottom of the containers.

Group	Day 8	Day 13		
	Top	Average*	Top	Bottom
A	0.86^{b}	0.73^{b}	0.62^{de}	0.82^{cd}
B	-	0.78^{b}	0.94^{bc}	0.61^{de}
C	0.61^{c}	0.72^{b}	0.65^{de}	0.79^{cd}
D	0.89^{bc}	0.67^{b}	0.52^{e}	0.84^{cd}
E[1]	-	-	-	-
F	0.89^{b}	0.78^{b}	1.22^{a}	0.33^{f}
G	1.38^{a}	1.09^{a}	1.09^{ab}	-
H	0.77^{bc}	0.67^{b}	0.67^{de}	-

[1]The packaging method applied for group E, where no cover was used on the container, was considered not applicable due to extreme dryness and toughness of the fish skin. The data collected for group E are therefore not included in present report.

As stated before, only fish from the surface of the containers were evaluated on day 8 but on day 13, nine to ten fillets were evaluated from both surface and bottom of the containers. The results obtained on day 13 indicated a rather large variation within groups (Figure 10). Therefore, generally no differences were observed between fillets from the surface and the bottom (Table 6). Considering the fillets from the bottom of the containers, the results indicated slightly more gaping ($p>0.05$) for fish stored in 60 cm deep containers (group A) than fish stored in 40 cm (group B and C) and 29 cm deep containers (groups D and F). Moreover, no effects from different types of cover were observed 13 days post packaging.

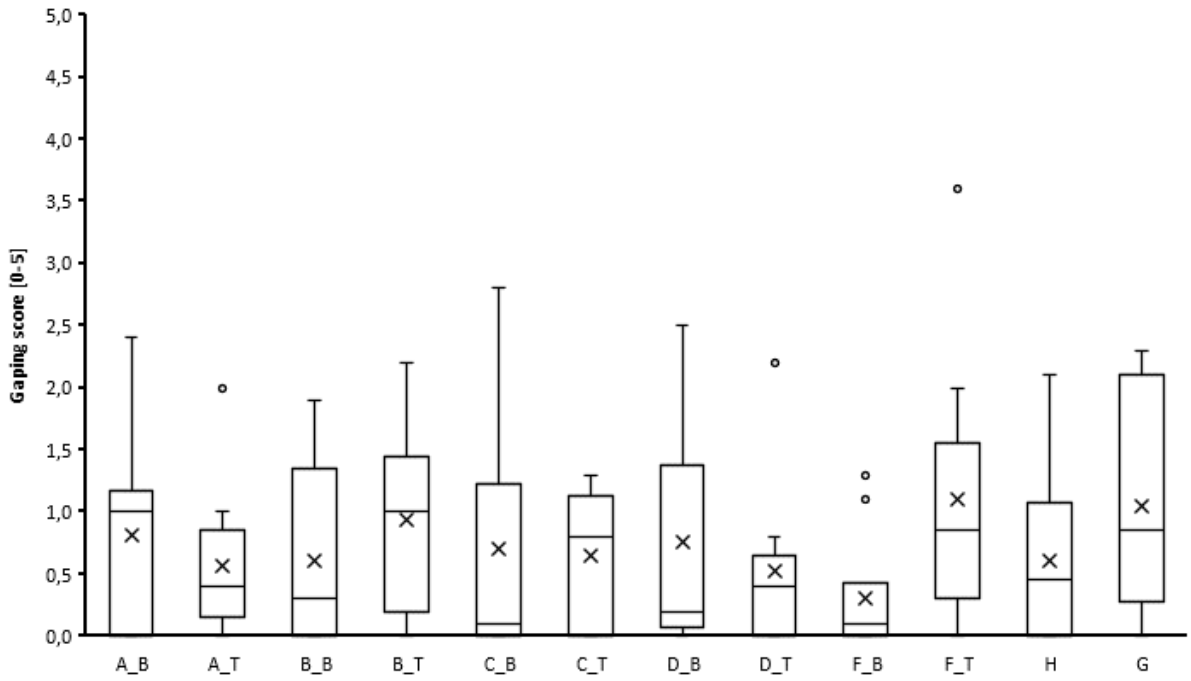

Figure 10. Boxplot for gaping in fillets after 13 days of storage at -1.4 °C. B and T in the sample name represent fish from the bottom and top of the containers, respectively. Description of different experimental groups can be viewed in Table 1.

Some difference was seen in elasticity of the fillets on day 8 (Table 7). The lowest fillet elasticity was observed for fish stored in 380 L containers with plastic cover (group A) and the highest for fish stored in 250 L container with covered with thin lid. No difference in fillet elasticity was observed between the experimental groups on day 13.

Table 7. Elasticity of fillets 8 and 13 days post packaging and storage at -1.4 °C. On day 8 only fish from the surface (top) of the containers were evaluated (n=17-20), while on day 13 fish from both top and bottom of the containers were evaluated (n=9-10). Different letter within column indicate significant statistical difference between groups (p<0.05). Description of different experimental groups can be viewed in Table 1. *Average elasticity score from fish collected both from the surface (top) and bottom of the containers.

Group	Day 8	Day 13		
	Top	Average*	Top	Bottom
A	1.22[a]	1.42	1.78	1.10
B	-	1.50	1.50	1.50
C	0.56	1.26	1.22	1.30
D	0.33[b]	1.39	1.33	1.44
E[1]	-	-	-	-
F	0.24[b]	1.61	1.56	1.67
G	0.35[b]	1.94	1.67	-
H	0.82	1.67	1.94	-

[1]The packaging method applied for group E, where no cover was used on the container, was considered not applicable due to extreme dryness and toughness of the fish skin. The data collected for group E are therefore not included in present report.

Similar as for the fillet elasticity, no difference in fillet softness was observed between the experimental groups on day 13 (Table 8). The average values ranged between 1.1 to 1.4 which indicated neither firm nor soft texture of the fillets.

Table 8. Softness of fillets located either in the top or the bottom of the containers after 13 days of storage (n = 9-18). Description of different experimental groups can be viewed in Table 1.

Group	Top	Bottom
A	1.44	1.00
B	1.30	1.40
C	1.22	1.10
D	1.22	1.44
E*	-	-
F	1.00	1.11
G	1.17	-
H	1.33	-

*The packaging method applied for group E, where no cover was used on the container, was considered not applicable due to extreme dryness and toughness of the fish skin. The data collected for group E are therefore not included in present report.

3.3 Microbial quality

To evaluate the microbial quality of the fish, total viable count (TVC) and Listeria activity were analysed on day 8 post packaging, as well as TVC on day 13 (Table 9). No Listeria was detected in any of the analysed samples. Considering the fish stored in containers, the lowest TVC on day 8 was in the top layer of group D and bottom layer of group C, representing a 250 L container covered with plastic bag and 460 L container with lid and grid in the bottom, respectively. However, no significant difference was observed between the different experimental groups on day 8. Considering the fish stored in EPS boxes, superchilling before packaging had significant effects on the TVC where the TVC of the superchilled fish was below the detection limits. The TVC increased in all experimental groups with extended storage time, but the differences between groups were not significant on day 13 post packaging with the exceptions of group B. The TVC of group B, representing bottom layer of 460 L container covered with plastic bag, was below the detection limit on day 13.

Table 9. Total viable count (TVC; log cfu/g muscle) of the experimental groups after 8 and 13 days storage at -1.4 °C. Description of different experimental groups can be viewed in Table 1.

Group	Day 8		Day 13	
	Top	Bottom	Top	Bottom
A	-	-	-	2.3 ±0.3
B	-	-	-	0.5 ±0.7
C	1.6 ±0.4	0.7 ±0.9	2.0 ±0.1	2.1 ±0.3
D	0.5 ±0.7	1.3 ±0.5	2.6 ±1.0	2.4 ±0.0
E*	-	-	-	-
F	1.7 ±0.1	-	2.5 ±0.4	-
G	1.7 ±0.6	-	2.8 ±1.2	-
H	<1	-	2.4 ±0.4	-

*The packaging method applied for group E, where no cover was used on the container, was considered not applicable due to extreme dryness and toughness of the fish skin. The data collected for group E are therefore not included in present report.

4 Discussions and conclusions

The results obtained showed in general minor difference between different packaging methods. Different packaging material, container depth or type of container coverage had no effect on the bacterial load after 13 days storage at around -1 °C.

The results of fillet gaping showed generally more variation within experimental group than between different groups, indicating a large individual difference and/or difference in handling of the fillets during processing and filleting. Moreover, the results suggested that the effects of the different packaging methods of fish tested prior to filleting were minor on fillet gaping after 8 and 13 days storage at -1.4 °C. This include EPS boxes, containers of different depth and different container covers.

The effects of superchilling before packaging on fillet gaping was evident since fish packed in EPS box with ice (group G) resulted in more gaping than fish packed in EPS boxes and/or containers without ice. These findings were supported with the evaluation of fillets elasticity 13 days post packaging, where group G had the least average elasticity.

Overall, present study indicates that there is no difference between EPS boxes and the insulated fish containers tested based on the evaluated quality parameters. The results suggest that transportation of superchilled rainbow trout is a feasible option with regard to the raw material stability and product quality.

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GUIDE FOR EVALUATING FILLET TEXTURE IN ATLANTIC SALMON

Introduction

The purpose of this guide is to develop a standardised method to evaluate firmness in salmon that may be used to characterise texture. It is important to stress that the **industry test** is not designed for general assessment of the fillet texture during storage and transport (such as, for instance, the equivalent Quality Index Method). The industry test is rougher and is designed to detect significant texture-related quality defects resulting from the farming phase.

This guide is one of the results from the project *Industry test and training*, which was financed by the Fishery and Aquaculture Industry Research Fund (FHF).

Description of method

The industry test is designed to be as self explanatory as possible, so few additional comments are provided here. The industry test comprises three separate tests, which can be added up to provide a total score. The three tests shall be carried out in the following order (score stated in brackets):

1. Inelasticity (0 - 2)
2. Softness during finger test (0 - 2)
3. Gaping in loin, belly and tail (0 - 5)

Two of the three tests have a score from 0 to 2, whereby 0 is best and 2 worst, while the gaping score is from 0 to 5, whereby 0 is best and 5 worst. The evaluation is carried out jointly for the lion, belly and tail.

The method shall simulate filleting of salmon post-rigor. This may seem like a somewhat brutal way of handling the fillet, but it has been shown that the method reflects the differences that can be traced back to characteristics in the fish prior to filleting.

In order to provide an accurate evaluation, the fish must be post-rigor, so the test is carried out on fish that has been stored for three days or more.

This guide does not discuss where the line is drawn for commercial acceptance or for good quality. It is therefore up to the trade to agree upon the limits for acceptable quality.

Performing the industry test

Gutted salmon is chilled on ice for three days or more before the left fillet is cut out and trimmed to C –trim (pin-bone in) prior to evaluation.

Evaluate inelasticity by folding the fillet over on the table, releasing it and observing:

The elasticity in the fish muscle expresses whether the fish muscle can be folded over and then return to its original form. The longer the fish is stored; the fillet will lose elasticity and become more inelastic.

Score	Description
0	– Elastic: The fillet straightens out quickly
1	– Somewhat elastic: The fillet straightens out slowly
2	– Inelastic: The fillet remains folded over

Softness during finger test:

This method expresses softness in the fillet and shall be carried out on a point just under the dorsal fin, as shown in the photos. Press your finger at a 45°angle towards the fillet, with a pressure of approx. 1 kg – preferably with the fillet on balance to apply the correct pressure for two seconds.

Place your finger as such when testing softness.

Score 0 – Firm fillet: The surface is restored a short time after the finger pressure ends.

Score 1 – Reduced firmness: The finger pressure leaves a lasting imprint that is not restored.

Score 2 – Soft fillet: The finger goes right through the fillet and causes a clear rupture between the segments.

Gaping

Gaping is evaluated in three zones on the fillet: loin, belly and tail. To provoke gaping, the fillet shall be exerted by breaking it with a certain force. Start in the neck region and fold the loin sideways, as shown on the photo, and then continue along the fillet backwards until you reach the tail. Repeat in the same manner for the belly then evaluate the degree of gaping by comparing the fillet with the photos.

Score table for evaluation of gaping:

Score 0

Score 1

Score 2

Score 3

Score 4

Score 5