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Nofima
Norwegian Institute of Food, Fisheries and Aquaculture Research

Oxidative Stability of Salmon Oil

Leivers[1], **S.**, Haugen[1], JE., Dalheim[2], L., Oterhals[3], Å., Mozuraityte[4], R.

[1]Nofima AS, Osloveien 1, NO-1433 Ås, Norway, shaun.leivers@nofima.no, [2]Nofima AS, Muninbakken 9-13, 9019 Tromsø, Norway
[3] Nofima AS, Kjerreidviken 16, 5141 Bergen, Norway, [4] SINTEF Ocean, Brattørkaia 17C, 7010 Trondheim, Norway

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Investigating factors that affect the quality, stability and long-term shelf life of Norwegian salmon oil

Background

Most of the oil extracted from farmed salmon is used in animal feed and pet food. In order to use this oil for human consumption, thereby exploiting potential health benefits while increasing the economic value of the oil, it must adhere to strict quality requirements. Marine oils, however, are particularly susceptible to oxidation (high unsaturated fat content) and subsequently incur a reduction in nutritional and economic value, while also imparting potentially negative health effects. Therefore, it is key to measure the initial quality by physical and chemical analysis of salmon oils via an initial screening phase.

Screening

In total, 15 batches of salmon oil were collected from 5 different companies (Fig. 1). Samples varied by raw material, processing conditions and whether antioxidants were added. Oil samples were collected and stored at -40°C, until analysis. Samples were then screened, using a combination of chemical and physical parameters. Screening included oil quality analysis such as PV, AV, Free fatty acids (Fig. 2) and HS-GCMS (Fig. 3) for key lipid oxidation compounds (Hexanal and 1-Penten-3-ol). Astaxanthin content and fatty acid composition were also determined.

Figure 1. Collection and distribution of salmon oils

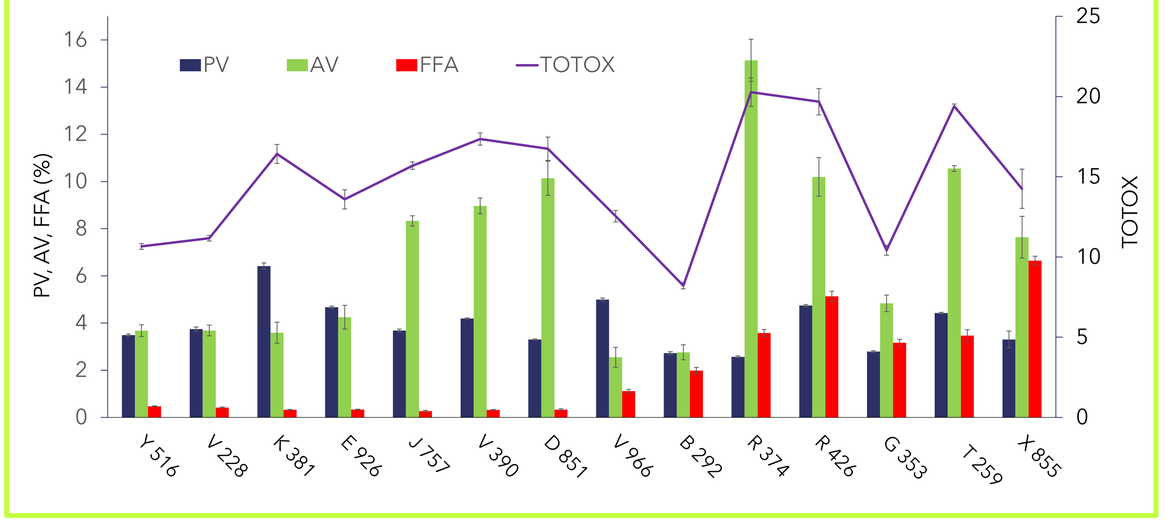

Figure 2. Typical oil quality parameters – Peroxide Value (PV), Anisidine Value (AV), Free Fatty Acids (FFA), Total Oxidation Value (TOTOX).

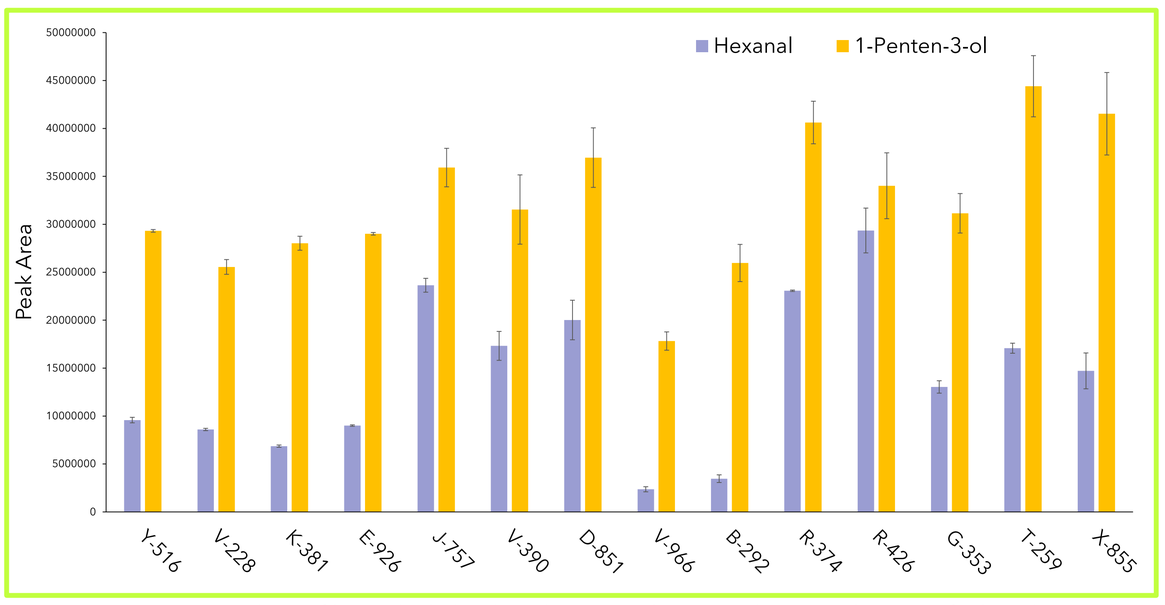

Figure 3. HS-GCMS analysis of key volatile lipid oxidation products, used as an indication of oil quality.

Refining

From the screening and characterisation of the oils, two were chosen to be refined. The refining procedure was carried out at TERRA, part of the University of Liége in Gembloux, Belgium (Fig. 4). It consisted of first bleaching the crude oils, followed by a deodorisation step, performed over 3 hours, with samples being taken every hour. As with the screening step, key quality parameters were monitored using PV, AV and FFA analysis (Fig. 5). A visual and olfactory inspection was also conducted at each stage during the process (Fig. 5 Inset).

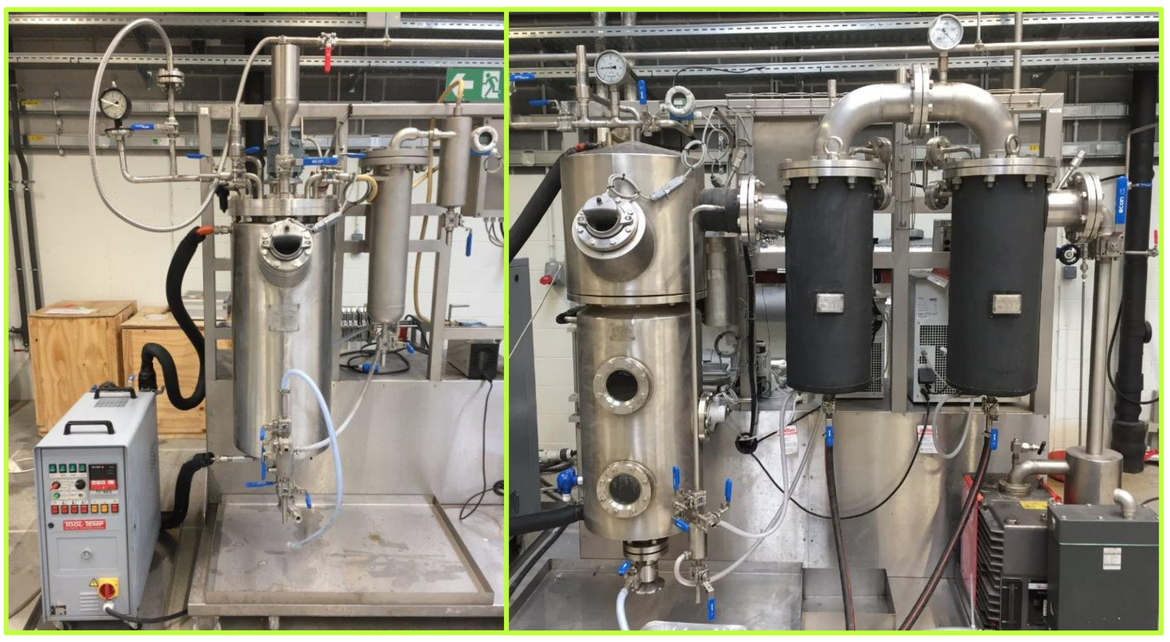

Figure 4. Refining equipment used in this study, Left – Bleaching, Right - Deodorising

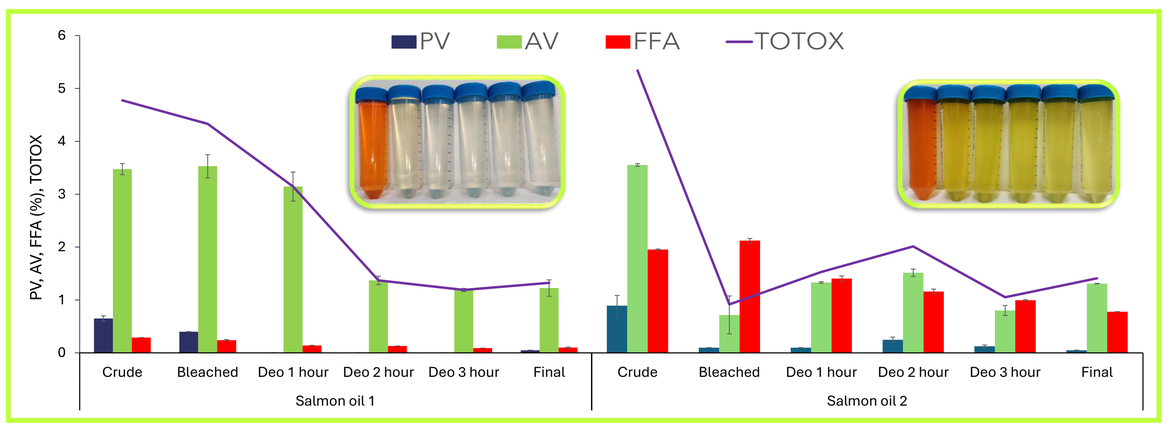

Figure 5. Oil quality parameters used to follow the progress of the refining procedure

Results

Screening – Analysis revealed differences, to a degree, across all samples. PV and AV values correlated with the addition of antioxidants (and lipid oxidation products found by HS-GCMS), while the FFAs were potentially dependant on the production methodology, while differing astaxanthin levels could be related to the source of raw material.

Refining - Clear reductions across all measured parameters were observed (Fig. 5), while differences between the refining of each individual oil was also clear to see. Further analysis, including NMR, HS-GCMS and oxidative stability testing are currently in progress.

Ongoing Studies

Further work in this project will be focused on the stability of the two refined salmon oils. A combination of different types and levels of antioxidants will be used to assess the long-term oxidative stability of the oils through classical accelerated storage (40°C with sampling at 0, 2, 4, 6, 8 weeks). Samples will be monitored by PV, AV and HS-GCMS for VOCs.

Figure 6. Preparation of samples for storage trials

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Nofima: *P.O. Box 210, Osloveien 1, NO-1433 Ås, Norway, Tel: +47 77 62 90 00, www.nofima.no, post@nofima.no – Norwegian Institute of Food, Fisheries and Aquaculture Research.*