NAMMCO

THE
NORTH ATLANTIC MARINE MAMMAL COMMISSION

EXPERT MEETING ON POTENTIAL POSITIVE HEALTH EFFECTS OF CONSUMING WHALE AND SEAL OIL

3 October 2007
Hotel Maritime, Copenhagen, Denmark

Meeting Report

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North Atlantic Marine Mammal Commission
Address: Polar Environmental Centre, N-9296 Tromsø, Norway
Tel.: +47 77 75 01 80/78, Fax: +47 77 75 01 81 Email: nammco-sec@nammco.no

Expert meeting on potential positive health effects of consuming whale and seal oil

3 October 2007

Hotel Maritime, Peder Skrams Gade 19, 1054 København K.Copenhagen, Denmark

Meeting Report

Chair: Lars Walløe, University of Oslo
Rapporteurs: Christina Lockyer and Mario Acquarone, NAMMCO Secretariat

Introduction:
Lars Walløe expressed his warmest welcome to the convened delegates.

Christina Lockyer, General Secretary, introduced the NAMMCO Secretariat Staff and instructed on practicalities and house facilities. She also communicated Per Møller's regards, his regret for being unable to participate in this meeting and that his PhD-thesis was available at this meeting for anyone wishing to consult it. Lars Walløe communicated that Bruce J. Holub from Guelph, Canada and Jens C. Hansen from Århus, Denmark could unfortunately not attend. There followed a round-table introduction of all participants.

Marine Mammal oils have high concentrations of n-3 fatty acids which are beneficial to health and which are present in high levels in other marine oils (e.g. cod liver oil). About 30 years have passed since the publication of the first study of the effect of marine mammal oils (in the form of blubber and meat mostly) in the diet on Greenlandic and Danish populations. Many studies have followed. Recent marketing, for example the product Sel-Olje (Biopharma AS) in Norway, underlines some beneficial properties of seal oil which would be discussed today. These statements have to be examined scientifically and critically before evidence of beneficial effects can be confirmed.

1. Effects on intestinal diseases

Presentation by Tormod Bjørkkjær, National Institute of Nutrition and Seafood Research (NIFES) and Arnold Berstad, University of Bergen

Controlled Study: Effect of seal oil vs soy oil on Joint Pain as a complication of Inflammatory Bowel Disease (Doc 7, published)

Nineteen patients suffering from Inflammatory Bowel Disease (IBD)-related joint pain (about half of the patients had arthritis), most of which had chronic disease for years, were treated for ten days with dose of 3x10 ml/day unrefined seal (Canadian origin, a mixture of Harp and Hooded seal oils) or soy oil via naso-duodenal tube. The patients treated with seal oil showed improvement, mostly within 10 days, in their rheumatic symptoms (morning stiffness, tender joints, doctors' scoring of rheumatic disease activity and intensity of pain during the previous week) and serum fatty acids profile compared with soy oil. The effects on rheumatic symptoms (morning stiffness, doctors' scoring of rheumatic disease activity and health-related quality of life) of seal oil persisted for 6 month as compared with soy oil. It was noted that these rheumatic symptoms were not the same as rheumatoid arthritis and patients do not have elevated cytokines or CRP in general. Bjørkkjær *et al.* 2006 (*Lipids Health Dis.* 5:6) showed additional results from the pilot study (Arslan *et al.* 2002 (Lipids 2002;37:935–40)) and the controlled study (Bjørkkjær *et al.* 2004 (*Scand. J. Gastroenterol.* 39:1088–1094)). Results were normalization of fatty acid profiles of rectal mucosa from IBD-patients after seal oil treatment compared with controls and amelioration of bodily pain using SF-36 questionnaire compared with soy oil treatment.

PhD Study by Linn Anne Bjelland Brunborg (PhD Thesis at the University of Bergen/NIFES 2006, but the following study is unpublished)

In this study, unlike the previous one, seal oil was compared with cod liver oil both rich in omega 3 lipids. Thirty-eight IBD patients with joint pain (15 with arthritis) were treated for 14 days with and oral supplementation of refined Canadian Harp seal or cod liver oil (3x10 ml per day). Baseline level was low joint pain. The study did not show any significant differences between the groups as both showed tendency of reduced rheumatic symptoms, significant only for cod liver oil group (joint pain intensity and patients' global assessment). There were no differences in effect on serum fatty acid composition or in LTB4 levels in plasma as both were significantly improved.

A comparison of seal oil (Canadian, refined) and whale oil (Minke whale, refined) on joint pain in patients with IBD (unpublished).

18 patients (4 with arthritis) were given either seal oil (n=9) or whale oil (n=9) for 10 days (3x10 ml/d) using a naso-duodenal tube. Restrictions were imposed on seafood/n-3 intake one week before study and during treatment. There was a favorable improvement in fatty acid profile, intestinal symptoms and rheumatic symptoms in both groups after treatment (but no group differences). There was a reduction in prostaglandin E2 among the seal oil group only (there was no comparison with whale oil). 78 % of patients were unaware of which oil they received based on a post treatment questionnaire.

Discussion:

- Choice of soy oil in the first study was queried as this is high in n-6 fatty acids and is known to inflammatory properties.
- It was queried whether there was likely to be difference between refined vs unrefined seal oil. It was pointed out that Inuit populations traditionally consume raw seal and whale blubber and not cold pressed or refine oils.
- There was a good compliance by the patients in the second study because the refined seal oil did not smell.
- It was discussed how there could be an objective scale to measure joint pain.
- It was pointed out that the absence of a control group was due to the easy detectability of water versus oils. But test blindness could be controlled by a post study questionnaire where the patients could indicate what they considered was the administered substance.
- Statistics: these studies involved parametric tests and it was mentioned that non parametric tests would probably be more appropriate.
- Recommendations for future studies included a greater sample size of patients and a greater focus on randomization and control.

2. Seal Oils and Food Hypersensitivity

Presentation by Arnold Berstad, Faculty of Medicine, University of Bergen

Food hypersensitivity: Would Seal Oil affect Gastric Accommodation? (Unpublished)

Gastric accommodation, a natural reaction caused by the ingestion of food, does not take place in patients with symptoms of functional dyspepsia (caused for example by stress). Stress reduces the extent of gastric accommodation causing gastric accumulation. The resulting increase in pressure in the antral area of the stomach gives symptoms ranging from discomfort to vomit. The effect of seal oil on gastric accommodation was measured non-invasively by ultrasound.

Two experiments were performed on patients with food hypersensitivity and Irritable Bowel Syndrome (IBS not IBD as above):

- Acute Experiment: one naso-jejunal administration on consecutive days of 3 x 10 ml saline solution, seal or soy oil was followed after 10 min by a test meal (500 ml of very thin clear soup that changes the motility of the stomach from fasting state to fed state). The motility of the stomach and the dimensions of the distal part of the stomach were measured by ultrasound before and after oil administration and again immediately after the test meal and after further 10 min.
- 10 days' Experiment: the patients' gastric adaptation response to a test meal was measured before 10 days of naso-jejunal administration with seal or soy oil (3x 10 ml/day). The same type of measurements, as in the acute experiment, were taken after the end of the treatment.

Results:

- Acute Experiment: there was no significant difference in the effect of saline or oils on antral area or symptoms in response to the administration of the test meal.
- 10 days' Experiment: there was a slight decrease in general symptoms (symptom scores) after the treatment with seal oil but no difference in the treatment with soy oil. However there were no clear differences in antral area measurements before and after the treatments for either of the oils.

Food hypersensitivity is an increasing health problem which has not previously been addressed by treatment with seal oil. In this study there was no clear effect of the treatment with either type of oil (seal or soy). However seal oil treated patients had less symptoms compared to those treated with soy oil. The suggestion is that the beneficial effect is due to COX-inhibition because reports suggest increased production of PGE2 in food hypersensitivity; experimental findings here indicate reduction of plasma PGE2 by dosing with seal oil.

Seal oil had no effect on (vagally mediated) gastric accommodation (i.e. symptomatic benefit cannot be ascribed to altered gastric accommodation). It was not clearly reported what happened with the control group (which was administered saline solution) in the 10 days' experiment.

3. Effects on skin diseases

Presentation by Tormod Bjørkkjær, National Institute of Nutrition and Seafood Research (NIFES) and Arnold Berstad, University of Bergen

Therapeutic use of seal oil for the treatment of Psoriatic Arthritis (PsA) (Doc 6, published)

Forty patients suffering from PsA were treated with oral doses (3x10 ml/day) of refined seal (20 patients) or soy oil (20 patients) for 14 days. The refined seal oil originated from Rieber Skinn AS in Norway. Patients were allowed to continue non-steroidal anti-inflammatory drugs (NSAID) and disease modifying anti-rheumatic drugs (DMARD) during the study. An assessment was carried out after 2 and 6 weeks.
The results indicated that there was:

- No dermatological change for either treatment
- A subjective improvement in global assessment of the disease in the seal oil group
- A tendency in reduction of tender joints for both treatments
- An improved fatty acid profile in the serum after two weeks (seal oil)
- An improvement (*reduction*) in total and LDL-cholesterol levels for the soy oil treatment after two weeks
- 37.5% of patients were unaware of which oil they received according to a post-treatment questionnaire

As a general conclusion there was:

- No marked difference between treatment with soy or seal oil
- A significant subjective improvement in global assessment of the disease in the seal oil treated group after 6 weeks

Discussion:

- A recommendation for studies including a larger number of patients was made
- It was underlined that oral treatment can give problems with compliance due to the marked differences in palatability among the oils.
- It appears that no studies have been made regarding lower dosage of oils.
- In Doc 6, Table 3 the calprotectin levels in blood (proposed as a marker of inflammation but with variable results) increased within seal oil and decreased within soy oil (there were no significant group differences or within group changes).
- There is definitely a need for controlled experiments/studies on the effects of seal and whale oil on skin diseases, and also on refined versus unrefined oils.
- As yet there are no studies on topical applications of marine oils on skin diseases, but some trials on this subject will be initiated shortly in Tromsø.
- Reaction to fish oil could be different according to the subject's diet (do the patients already include fish in their normal diet?)
- Some products of fish oil oxidation are cell proliferation inhibitors. A recommendation was made to initiate studies on the effects of oxidation or non-oxidation of lipids.

4. Effects on cardiovascular diseases

Presentation by Bjarne Østerud, Faculty of Medicine, University of Tromsø

Effects of Marine Oils Supplementation on Coagulation and Cellular Activation in Whole Blood (Doc 1, published)

Olive, whale oil (cold pressed) seal and cod liver oils were administered alone or mixed to 134 healthy adults. The study showed that after 10 weeks of supplementation (15 ml/d) their levels of HDL (good cholesterol) in serum were higher for those treated with whale oil or a combination of seal and cod oil, but not for those treated with cod or seal oil alone.

Fibrinogen, Factor VII coagulant, Prothrombin fragment levels were also monitored and it seems that treatment with seal/cod liver oil and whale oil can that lower them significantly. Tumour Necrosis factor-alpha (TNF-α), Tissue factor (TF) activity and production of Thromboxane B_2 (TxB_2) were also inhibited.

A questionnaire at the end of the study showed that the participants were not aware of the treatment they were receiving thus ensuring test blindness.

Discussion:

- In any experimental design using marine mammal n-3 oils it is important to screen all trial participants as to what they are consuming already (e.g. fish diet).
- Could blubber be contaminated with environmental pollutants? Levels of pollutants are lower now than they were in the 1990's and should no longer be a problem. The beneficial effects of two spoons of oil a day largely outreach the negative effects of the pollutants that might still be included in the oil.

Effects of Dietary Marine Oils and Olive Oil on Fatty Acid Composition, Platelet Membrane Fluidity, Platelet Responses, and Serum Lipids in Healthy Humans (Doc 2, published)

The influence of various dietary marine oils and olive oil on fatty acid composition of serum and platelets and effects on platelets and serum lipids were investigated as part of an extensive study of the effects of these oils on parameters associated with cardiovascular/thrombotic diseases.

Healthy volunteers (266) consumed 15 ml/d of cod liver oil (CLO); whale blubber oil (refined or unrefined); mixtures of seal blubber oil and CLO; or olive oil/CLO for 12 weeks.

In conclusion, intake of various marine oils causes changes in platelet membranes that are favorably antithrombotic. The combination of CLO and olive oil may produce better effects than these oils given separately. The changes in platelet function are directly associated with alterations of fatty acid composition in platelet membranes.

A Long-Term Seal- and Cod-Liver-Oil Supplementation in Hypercholesterolemic Subjects (Doc 9, published)

In this long-term study, the effect of dietary supplementation of seal oil (SO) as compared cod-liver oil (CLO) was studied on subjects with moderate hypercholesterolemia. The test parameters included fatty acid composition in serum, blood lipids, platelet aggregation, and the activity of blood monocytes. After a run-in period of 6 months, 120 clinically healthy hyper-cholesterolemic (7.0–9.5 mmol/L; 270–366 mg/dL) subjects were randomly selected to consume either 15 ml of SO or CLO daily for 14 months followed by a 4-month wash-out period. A third group was not given any dietary supplement (control). Consumption of marine oils (SO and CLO) changed the fatty acid composition of serum significantly. Maximal levels were achieved after 10 months. No further changes were seen after 14 months. A wash-out period of 4 months hardly altered the level of n-3 fatty acids in serum. Addition of SO gave 30% higher level of eicosapentaenoic acid, as compared to CLO. Subjects taking SO or CLO had lower whole-blood platelet aggregation than the control group. Neither SO nor CLO had any effects on the levels of serum total cholesterol, high-density lipoprotein cholesterol, postprandial triacylglycerol, apolipoproteins A1 and B100, lipoprotein (a), monocyte function expressed as monocyte-derived tissue factor expression, and tumor necrosis factor.

Enhanced Incorporation of n-3 Fatty Acids from Fish Compared with Fish Oils (Doc 3, published)

The influence of various dietary marine oils and olive oil on fatty acid composition of serum and platelets and effects on platelets and serum lipids were investigated as part of an extensive study of the effects of these oils on parameters associated with cardiovascular/thrombotic diseases.

A clinical trial comprising 71 volunteers, divided into five groups, was performed. Three groups were given 400 g smoked salmon (n = 14), cooked salmon (n = 15), or cooked cod (n = 13) per week for 8 weeks. A fourth group was given 15 ml/d of cod liver oil (CLO) (n = 15), and a fifth group served as control (n = 14) without supplementation.

No significant changes were observed in blood lipids, fibrinogen, fibrinolysis, or lipopolysaccharide (LPS)-induced tissue factor (TF) activity, tumour necrosis factor-α (TNFα), interleukin-8 (IL-8), leukotriene B4 (LTB4), and thromboxane B2 (T×B2) in whole blood.

The combination of CLO and olive oil may produce better effects than these oils given separately. The changes in platelet function are directly associated with alterations of fatty acid composition in platelet membranes.

Discussion:

- The length of studies should be at least eight weeks, but length of studies can affect compliance.
- Small changes in the balance of component oils (n-3/n-6) can have very variable effects.
- It was also indicated that consumption of salmon twice a week increased serum total lipid omega-3 concentrations more than daily ingestion of cod liver oil. No data are given to conclude whether this is caused by differences in intestinal absorption or differences in tissue distribution.

Mice treated with OliVita™ (olive oil and marine mammal oil) or corn oil

Following earlier presentations a combination of marine oils and olive oils may produce better effects than either alone. This study presented experimental treatment of atherosclerotic mice with OliVita™, corn oil or control. Pictures of the coronary arteries of the mice showed much greater oil induced lesions for the treatment with corn oil and controls than with OliVita™.

Discussion:

- Particular attention should be paid to the animal model chosen for human-aligned studies: pigeons may be better than mice.

5. **Dietary effects on the heart**

Presentation by Sigmundur Guðbjarnarson, Science Institute, University of Iceland.

Marine fat and health

Fatty acid composition in the diet is reflected in membrane phospholipids. The administration of catecholamines has an influence on the cardiac membrane phospholipids. Dietary cod liver oil decreases the affinity of a-receptors but increases the affinity of b-receptors to the agonists (catecholamines). Chronic stress is accompanied by a co-regulation of fatty acyl composition of the membrane and the properties of the membrane receptors.
Adaptation to stress has a similar regulatory effect on membrane phospholipid composition such as in:

- adrenergic stimulation
- neonatal stress
- restriction stress
- rapid weight loss

Dietary fats, stress and ventricular fibrillation (VF)
Model VF: old rats injected with isoproterenol which induces a decrease in high energy phosphates causing frequent development of VF during energy depletion. Mortality in this study was higher for rats fed with diets supplemented with 10% butter and lower in rats fed with 10% cod liver oil.

The availability of 22:6n-3 fatty acid may be important in avoiding fatal disturbances in heart rate (ventricular fibrillation).

Dietary fat, stress and cardiac necrosis (CHF)
Model CHF: young rats injected with high, repeated pulses of isoproterenol causing cardiac necrosis. In this study rats fed with 10% cod liver oil had a much higher mortality than rats fed butter or corn oil.

Docosahexaenoic acid in cod liver oil also reduced the level of arachidonic acid (AA) in cardiac phospholipids.

Dietary fats, emotional stress and gastric erosion
Rats were fed regular diets supplemented 10% corn or cod oil to reduce the levels of 20:4n-6 in phosphatidylcholine and phosphatidylethanolamine of the gastric mucosa and the stomach wall. The rats were then motility-restricted for 18 hours to induce stress. All rats developed gastric erosion, but twice as many lesions (gastric ulcers) were present in rats fed cod liver oil compared with those fed corn oil.

The low arachidonic acid in gastric phospholipids of rats fed the cod liver oil is actually weakening the protective eicosanoid production in stomach mucosa.

Myocardial lipids and coronary disease in man
Post-mortem degradation of myocardial phospholipids indicates that the stability of phospholipids is a function of the fatty acid composition of the cardiac membrane: more unsaturated fatty acids were released more readily than less unsaturated fatty acids.

Conditions which modify the fatty acid composition of cardiac phospholipids may thus influence stability of membrane phospholipids and thereby affect susceptibility to damage.

Increased un-saturation of membrane phospholipids is observed with certain diets, chronic stress and ageing.

Coronary artery disease in man
The fatty acid profile of cardiac phospholipids and non-esterified fatty acids (NEFA) were examined in human autopsy material.

The level of NEFA could give some information about changes in release of specific fatty acids during post mortem lipolysis indicating alterations in cardiac enzyme activities prior to death.

Analysis of muscle samples from individuals that died suddenly of coronary artery disease (with severe stenosis) showed reduced post mortem release of 20:4n-6 compared to other fatty acids and reduced NEFA levels, and the activity of P-lipase A2 seems to be impaired in patients with severe coronary stenosis (constriction or narrowing of the coronary artery).

Sudden cardiac death with no or mild coronary stenosis
Sudden cardiac death was frequently associated with:

- elevated myocardial levels of NEFA
- low levels of phosphatidylethanolamine (PE) and very low levels of 22:6n-3

High ratios of 20:4n-6/22:6n-3 was observed in cardiac phospholipids. The high ratio may be due either to impaired release of 20:4n-6 or due to decreased levels of 22:6n-3
Low levels of 22:6n-3 could also indicate increased breakdown of cardiac of PE rich in docosahexaenoic acid (DHA).

Summary

- Increased availability of DHA reduced the risk of stress induced ventricular fibrillation and sudden death
- Decreased availability of AA and increased levels of DHA in membranes increased the risk of stress induced tissue necrosis both in the heart and the stomach
- The balance between n-6 and 3-n fatty acids appears to be critical for adaptation to stress and stress tolerance
- This balance between n-6 and n-3 fatty acids in heart and muscle membranes is affected by chronic stress, ageing and dietary fats

Human versus whale heart
The whale heart has much more eicosapentaenoic acid (EPA) in phosphatidylcholine (PC) and phosphatidylethanolamine (PE) than the human heart. But the human heart has more AA in PC and PE than whale heart.

Whale diving reduces heart rate and coronary flow. Could EPA aid to increase ischemic tolerance in the heart?

6. The Eskimo diet?

Presentation by Gert Mulvad, Centre for Primary Health Care, Nuuk

The Eskimo diet has been under a lot of focus. But what is it and is it useful?
What are people actually eating in Greenland? The proportion of marine mammals, fish and birds in the diet varies throughout Greenland according to the region and the village. Each town has actually a different diet from the others. On average in Greenland 75% of

the calorie intake comes from imported food and 25% from local food. The Eskimo diet today is imported!

Post mortem study of PUFA in abdominal adipose tissue in Greenland Inuit (the sampled abdominal fat is supposedly the best to look at the long term average diet of a person), Alaskan Inuit and Alaskan Caucasians. The highest ratio of n-6/n-3 was present in Caucasians and lowest in Greenlandic Inuits. There was no direct correlation between n-3 lipids and the incidence of atherosclerosis. Coronary artery analysis showed clear differences between coronary and general atherosclerosis.

In earlier descriptions of the Greenlandic population indicated that nose bleeding was very frequent and very prolonged (18 min among Inuits and 4 min in Danes). Could it be due to too high levels of omega-3 fatty acids in the diet?

A study compared Greenlandic and Canadian n-3 Fatty Acid serum composition in post-menopausal women (EPA-20:5n-3, DHA-22:6n-3, DPA-22:5n-3). There is a clearly higher level of EPA, DHA and DPA in the Greenlandic subjects (Stark et al. (2002) Nutrition, 18:627-630). Could it be attributed to a higher level of a desaturase enzyme in the Greenland population (genetic component).

Dietary Supplements of Omega-3 PUFA fish or Seal oil capsules reduced menstrual discomfort in Danish women (B. Deutch et al. (2000) Nutrition Research, 20 (5):621-631).

Haemorrhagic bleeding in artery walls could also be due to high levels of Omega-3 fatty acids. This could mean that high levels of Omega-3 fatty acids increase the risk of dying from haemorrhagic stroke.

Obesity is an increasing problem in Greenland with an associated high frequency of diabetes and ischemic heart diseases. The latter were historically much lower in Greenland than in Denmark, but today the level of ischemic heart disease is the same in the two countries.

Cardiovascular disease though is not the same as ischemic heart disease and it is essential to separate the two. Ischemic heart diseases are effectively lower in Greenland than in Denmark but in general cardiovascular diseases are not and have not been less frequent than in Denmark.

Therefore it is necessary to consider carefully what we say about the “Eskimo diet”.

7. Other effects

Per Møller’s PhD thesis (Doc 11, presented by Christina Lockyer) comprised a synopsis and 7 scientific papers of which 4 were relevant to this meeting. These papers covered topics of nutritional lipid quality of West Greenland marine species, dietary composition and health indicators in North Greenland in the 1970s and today, and dietary composition and contaminants in North Greenland in the 1970s and 2004, and finally impairment of cellular immunity of sledge dogs fed polluted minke whale blubber. The nutritional lipid analysis indicated that marine mammal muscle and blubber have the highest n-3/n-6 ratios compared to a variety of sea birds, fish and marine invertebrates; in some cases the n-3/n-6 ratios approach 10:1. The dietary composition and health indicators show a significant increase in body weight, BMI and obesity as well as cholesterol and triglyceride levels between 1976 and 2004 in both sexes. The last two papers address contaminant levels which were not originally part of the meeting agenda. However the natural contaminant levels (PCBs, DDT, DDEs and heavy metals) in dietary intake in the Inuit population have actually decreased between 1976 and 2004. This is a reflection of the fact that the consumption of locally produced food has decreased in Greenland during the last 30 years and this has led to a reduction in the daily intake of contaminants. However, the concentrations of contaminants in local food items have not decreased, except for PCB and Lead.

8. Comments on the Norwegian diet led by Kristian S. Bjerve:

In general the natural diet of a population, which is the background for any study, can change and has changed very rapidly as illustrated by figures of dietary changes in Norway between WWII and the post-war period showing variations in intake of fats.

The consequences of these changes are evident from figures of mortality by cardiovascular problems during the same period (also compared with other European countries).

N-3 Fatty Acids in S-phospholipids are highly correlated with the reduction of mean arterial blood pressure. On the other hand, the concentration of n-3 fatty acids in plasma total lipids is not a good indication of the composition of cellular membrane phospholipids.

Increase in EPA intake causes a decrease in blood pressure if 3 or less fish meals per week are consumed. However there is no real effect if more than 3 fish meals per week are already consumed.

The definition of baseline levels of active components is of utmost importance and methods to determine it should be developed. Diet has changed worldwide both in composition and in preparation method with clear health repercussions.

9. Conclusions

- Short-term (10 days) administration of seal oil (10 ml x 3) significantly reduces joint pain in patients with inflammatory bowel disease (IBD) (ulcerative colitis and Crohn’s disease) and in patients with psoriasis.

- Larger (more patients) studies are needed to document beneficial effects on the intestinal symptoms, but preliminary results are promising.

- Controlled studies of effects of seal oil on joint pain and inflammatory reactions in (other) rheumatic diseases are strongly needed, but a number of uncontrolled opportunistic reports of beneficial effects are interesting.

- Seal oil (but not soy oil) reduces symptoms in patients with food hypersensitivity.

- Seal oil has been shown to reduce menstrual discomfort in placebo controlled studies.

- Seal and whale oil has COX-2 inhibiting properties and thus general pain reducing effects similar to NSAID drugs. The oils have a number of advantages over NSAIDs, since they are not associated with the serious gastrointestinal and cardiac complications of these drugs. Many, but not all, of the effects above are likely caused by the COX-2 inhibiting properties of seal and whale oils.

- Intake of seal and whale oil is effective in reducing the reactivity of blood cells and reducing the activation of coagulation in a favourable nonthrombotic direction. This property may be the explanation of the low incidence of myocardial infarction in the Greenlandic Inuit population.

- It is still uncertain whether harp seal oil and minke whale oil have properties better than fish oils, e.g. cod liver oil, mainly because the two types of oils have not been used in the same investigations.

- There are many reports, both old (back to the factory ship whaling period) and new, which claim beneficial effects on skin diseases (especially eczema and sore skin) of topical applications utilizing raw whale oil.

- Many of the beneficial properties of seal and whale oil must be related to the high content of ω-3 fatty acids in these oils. However, some of the beneficial properties could be related to antioxidants and other substances which are removed or destroyed during the refining operations. One possible solution is to mix the seal oil with an other oil which contains antioxidants, for example olive oil. Further research may identify the substances which are removed during refining, and thus make it possible to add some of them back after refining.

- In general the participants in the workshop seemed convinced that there are beneficial effects of supplementing an ordinary diet with marine mammal oils, both for the general population and for certain patient groups. However, many of these beneficial effects should be better documented in larger placebo controlled double blind studies conducted and analysed according to strict methodological rules.

There are many challenges for further studies:

- We don't know if the duodenal application through a nasal-duodenal tube really is necessary for the treatment of inflammatory bowel disease.

- We don't know the minimum effective dosage of oil? Could it be sufficient to administer 15 ml in a spoon twice a day (for joint pain)? The addition of antioxidants (e.g. olive oil) could perhaps allow a higher dosage (3 x 15 ml/day) necessary for treatment of IBD (an ordinary spoon takes 10 ml, a large spoon 15 ml).

- Patient compliance is a problem. Many patients (and healthy persons) do not like the taste and keep belching the oil for many hours, while others take 20ml at a time without problems. Compliance could perhaps be checked by adding a tracer in the oil (e.g. lithium).

- In placebo controlled experiments the taste of the oils has to be disguised. This may be difficult.

- It is not obvious which oil should be used as placebo in a placebo-controlled experiment. There are problems both with soy oil and olive oil. Some of the participants suggested the use of corn oil (the advantage of corn oil remains to be shown).

- It will be difficult to find a suitable population for future studies, at least in Norway and for studies related to joint pain, since many different brands of fish oils, seal oils and ω-3 rich preparations already are on the market and are widely used by some patient groups.

- It was suggested that it might be productive in future population studies to concentrate on application areas (e.g. cardiovascular disease). A specialist cardiology panel could then address matters such as primary and secondary endpoints of a disease prevention study and how to educate and treat a future population potentially subject to high incidence of heart disease (primary prevention) or a population composed of persons who have had a myocardial infarction (secondary prevention).

List of Documents

DOC01: Østerud *et al*: Effects on marine oils supplementation on coagulation and cellular activation in whole blood. (*Lipids* 30, no 12: 1111-1118 (1995)).

DOC02: Vognlid *et al*: Effects of dietary marine oils on olive oil on fatty acid composition, platelet membrane fluidity, platelet responses and serum lipids in healthy humans. *(Lipids* 33, no 4: 427–436 (1998)).

DOC03: Elvevold *et al*: Enhanced incorporation of n-3 fatty acids from fish compared with fish oil. *(Lipids* 41, no 12: 1109–1114 (2006)).

DOC04: Editorial: Marine Oils for Anti-inflammatory Effect — Time to Take Stock. (extract from Cleland & James: *J. Rheumatol.* 33:207 (2006)).

DOC05: Editorial: Psoriasis, Psoriatic Arthritis, or Psoriatic Disease? (extract from Madland *et al*: *J. Rheumatol.* 33:210 (2006)).

DOC06: Madland *et al*: Subjective improvements in patients with psoriatic arthritis after short term oral treatment with seal oil. A pilot study with double blind comparison to soy oil. (*J. Rheumatol.* 33:307–10 (2006)).

DOC07: Bjørkkjær *et al*: Reduced joint pain after short term duodenal administration of seal oil in patients with inflammatory Bowel disease: Comparison with soy oil. (*Scand. J. Gastroenterol.* 11: 1088-1094 (2004)).

DOC08: Elvevoll and Østerud: Impact of processing on nutritional quality of marine food items.

DOC09: Brox *et al*: A long term seal and cod liver oil supplementation in hypercolesterolemic subjects. (*Lipids* 36, no 1:7-13 (2001)).

DOC10: Holub: Effects of Seal Oil Supplementation on Risk Factors for Cardiovascular Disease in Human Subjects Including Commentary on Unpublished Research and Future Considerations, PowerPoint presentation.

DOC11: Møller, P. (2006). Lipids and stable isotopes in marine food webs in West Greenland. Trophic relations and health implications. PhD thesis. National Environmental Research Institute, Denmark. 212 pp. http://www2.dmu.dk/1_viden/2_Publikationer/3_Ovrige/rapporter/PM_PhD.pdf

List of Participants

FAROE ISLANDS
Sjurdur Olsen, Danish State Serum Institute, Copenhagen

GREENLAND
Gert Mulvad, Centre for Primary Health Care, Nuuk
Amalie Jessen, Greenland Home Rule, Nuuk and NAMMCO Council (half day)
Jens Jacobsen, Greenland Home Rule, Nuuk (half day)
Leif Fontaine, fisherman and Hunter, Sisimiut (half day)
Ole Heinrich, Greenland Home Rule, Nuuk (half day)

ICELAND
Sigmundur Guðbjarnarson, Science Institute, University of Iceland, Reykjavik

NORWAY
Lars Walløe, Faculty of Medicine, University of Oslo
Bjarne Østerud, Faculty of Medicine, University of Tromsø
Arnold Berstad, Faculty of Medicine, University of Bergen
Tormod Bjørkkjær, National Institute of Nutrition and Seafood Research (NIFES)
Kristian S. Bjerve, Faculty of Medicine, NTNU, Trondheim

INDUSTRY
Ole Mindor Myklebust, Myklebust Trading, Norway
Asgeir Sæbø, Pharma Marine AS

NAMMCO Secretariat
Mario Acquarone
Christina Lockyer
Charlotte Winsnes