

NORWAY OPENS A NEW PAGE IN HISTORY OF ANTARCTIC KRILL FISHERIES

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Information about the large-scale project of the Norwegian company «Aker BioMarine» and the utilization of South Antarctic krill (*Euphausia superba*, Dana) resource has been researched.

Construction of larger and modern fishing vessels for krill fisheries and processing is foreseen, either Norwegian as well as other owners; also the introduction of new technologies on krill catch and resulting products, such as krill oil, Astaxanthine-like antioxidants and other unique preparations. At present, krill products produced by Aker Biomarine company are mainly directed towards the supply of Norwegian and other world aquaculture farms with specialized feed/fodders requirements, and in the future – plan moves towards new types of products and markets. First being this oriented to the pharmaceutical and food industry.

Fears about the possible negative consequences of the Norwegian-South Antarctic krill fishery on the ecology of the areas where this fishery is carried out are real, and analyzed in our paper.

In this paper preparation, material and proceedings of the 24th and 25th CCAMLR Sessions, as well as many other publications plus results of the author's own research were used¹ as well.

Antarctic krill (*Euphausia superba*) is one of the largest backlogs of animal-origin protein on the planet. This is largely an underutilized resource. Total allowable krill catch in the Atlantic sector of Antarctic region, established by CCAMLR, is 4.0 million ton, while in the Indian Ocean Sector (within Community Sea) – 1.5 million ton.

Meantime, in the period of the most intensive krill fishery within the Antarctic waters, from 1978 till 1992, annual average catch by all countries working at that time was 0.35 million ton, maximum being about 0.5 million ton. Since 1985, almost the only one area of commercial krill fishery has been the Antarctic part of the Atlantic Ocean (APA). The fishery is conducted in offshore areas mainly off-South Orkney Islands, South Shetland Islands and the Island of the South Georgia.

¹ CCAMLR – Commission on Conservation of Antarctic Marine Living Resources. 23 states are CCAMLR members, Ukraine, EU and 4 affiliated countries included.

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Since 1993, krill catch has been on the low side. The average annual catch for the period ranging from 1993 till 2006 was 0.105 million ton only (of them, about 15 % falls to the share of Ukraine). This volume is 3 times lower than the similar index for the preceding 14-year period. The principal reason of this low krill-commercial catch effort is explained by the termination of Russia's fishery, since 1993 (previously labeled as USSR or Soviet Union), and the diminished catch of Ukraine compared to the 1980s, when about 80 % of the world catch fell into their hands. Thus, reduction of krill catch after 1992 was not caused by a species depletion or over-exploitation of its fishery base [1, 2].

There is no doubt that krill is the key element of the Antarctic Region ecosystem, on the high-latitudinal part. It is the basic feeding resource for most animals of this region – mustaches whale, seals, fur seals, birds, many fishes species.

Krill has attracted researchers' attention long ago, first of all as a raw material for valuable albuminous products. Taste qualities of krill meat are similar to those of shrimp meat. It is rich in proteins (11-16 %) and contains 6 % of fat content. Krill proteins contain all set of irreplaceable amino acids, surpassing by far warm-blooded animals meat on these indexes, and corresponds to the albumen standard, accepted by FAO [3]. Krill tissues contain all macro- and microelements necessary for human beings, biologically active matters (BAM), including a wide complex of water- and fat-soluble vitamins and provitamins. Numerous researchers agree that food krill-derived products has radio protective and immunostimulating properties, and if taken regularly as a food, it promotes removal of radioactive nuclides and salts of heavy metals from the human organism while also reducing blood cholesterol level.

Not surprisingly, in 1970s, i.e. almost from the moment of the commercial krill fishery start, research began and it focused on obtaining pure krill meat. The krill meat processing method (as a stuffing agent) was developed in the Federal Republic of Germany and that of boiled and fresh-frozen meat – in the former Soviet Union by the specialists of All-Union Scientific Research Institute of Marine Fisheries and Oceanography (VNIRO) and other sector institutions of the Ministry of Fisheries ² [4-7].

Manufacturing of food-grade krill products has been performed in Japan, Poland, Germany, the USA and other countries. But the priority-production of canned and frozen krill meat on an industrial scale belongs to Ukraine. It became possible due to the construction of specialized large-capacity fish-krill supertrawlers – factories of the «Antarctida» type. Their design was carried out by «Gyprorybflot» (St. Petersburg); and they were built at the Nikolaev shipbuilding plant named after Nosenko.

² V. A. Bibik was present at the tasting panel of the first pilot lot of krill meat in 1978. The products were manufactured aboard r/v «Professor Deryugin» in the fishery area in the Community Sea by TINRO technology.

As a comparison, the value of the resulting food-grade products produced by these vessels (e.g. Ukrainian, former USSR) is about 90% higher compared to the total “revenue-commodity” output (revenue) value compared to the Norwegian feed-grade krill meal-quality focus. The other 10% value falls at raw krill used as a feed-grade meal.

It should be noted that production technology of food and feeding products used on these vessels meet ecological requirements of international organizations related to the activity performed in the Antarctic Region. The concept is that former operators were able to maximize each captured-ton financial-result through high-value added end products, compared to regular “revenue-commodity” target. For CCAMLR and its future fishing restrictions in the APA region, this “attitude” should and will become critical on their fishing permits procedures.

Unlike Ukrainian and American fishing companies, dealing mainly towards the food-related end-products, other countries companies pay greater, and sometimes sole attention, to the production of feed-grade krill meal and other types of feeding products.

Feed-grade krill meal is more expensive than fishmeal, the latter traditionally used in the aquaculture industry³. Krill meal contains a complete set of required amino acids, including irreplaceable ones. Aqua-feeds on the basis of krill products are of special attractiveness for Norway as its aquaculture industry, specialized in commercial-scale farming of valuable fish species (i.e. salmon, trout), as well as shrimps. In 2004 farm-grown production of salmon and trout was 650 thousand ton. Feeding these species and other aqua-species (cod, perches) Norwegian farms in 2004 consumed about 305 thousand ton of feed-grade marine meals; of which 100 thousand ton were imported [8]. In the nearest years, feed-grade marine meals imported by Norway will be partly compensated by feeding through krill products.

Krill resource used towards end-products related to feed-grade krill meal serves as initial raw material for more valuable end-product – krill oil rich in BAV for example. Its basic users are the aquaculture and the pharmaceutical industry. In the middle of 1990s, on-board krill oil production on vessels under the flag of Ukraine were planned, though not accomplished, by the Canadian company «Biozyme Systems Inc.».

Krill oil contains several unique components, including phospholipids, which have the complex fatty acids «Omega-3» in its composition. The use of «Omega-3» for human health wellness and overall health improvement is well known, although the deficit of natural good-quality raw material sources limits the production of the above mentioned preparations. Krill resource opens a wide prospect of food/pharma products and the use as an additive on various functional food products.

³ In Ukraine, at the beginning of 90s, the Government-state program of feeding meal production from sea-origin products, Antarctic krill including, was developed. The program was not-ended due to the lack of the necessary financing.

According to the known information provided to the media by the Norwegian holding company «Aker ASA», during the past few years, its branch «Aker BioMarine» has been focused on the issues concerned with the development of innovative methods of krill catch and processing. In 2006 the company decided to invest 170 million USD in the construction of the second «superproductive supertrawler-factory» for krill fishery and processing. Nonetheless, recently the company has changed this original plan and put aside this construction plan, rather concentrating back on an upgraded FT “Atlantic Navigator” version. It is expected that a two-operated Norwegian trawlers (one of them has already carried out fishery for a second year in a row as of the 2007 season) will allow the company to catch annually 200 thousand ton of krill. The basic types of products of the new trawler-factory will be feed-grade meal and krill oil [9].

Krill oil production technology can be based on different approaches. It is possible to apply enzymatic hydrolysis for albumens disintegration and freeing structural lipids, extraction of the dehydrated mass by polar solvents and electrophysical methods – electropasmolysis, electro-hydrodynamic blow, and ultrasound.

The krill oil solvent-extraction in the state of overcritical ectoplasm can be of special interest. Judging from «Aker BioMarine’s» information, the extraction method, using polar solvents will be probably used in their krill oil production layout. In this case, at the first processing stage, it is reduced to fragments, partly deprived of fat as a result of machinery activity and dried out. At the second stage, the extraction of fat is carried out with the formation of fat-free shrot⁴ and fatty mistrella⁵. The mistrella⁵ obtained is exposed to distillation with the receipt of fat and recovered solvent. Usually polar solvents – alcohols and their mixes – are used for extraction of polar lipids.

Annually, Norway’ «Aker BioMarine» plans to produce about 2.5 thousand ton of krill oil. Unfortunately, from the information provided by the company, it is not clear whether complete technological cycle will be carried out on-board their trawlers or the dried intermediate product will be processed on coastal facilities. There are also patent infringement complexities which may deprive «Aker BioMarine’s» reaching a successful market penetration. Infringement may come with some patent-holders, e.g. Canadian Neptune Technologies and Bioresources, which already possesses unique-patented (Phase I, II and clinical stage III on the pipeline) Krill Oil extraction procedures, well advanced also on R&D programs with mogul companies such as Nestle and Yoplait.

Due to the content of krill oil, fodder additives produced by «Aker BioMarine company» will increase the value of fish-target products, while the antioxidant Astaxanthine retains salmon and trout natural color of meat.

⁴ Fat extracted by organic solvent on any raw material, animal or vegetable (for us krill)

⁵ Oil solution in organic solvent

In 2004 the company sent the trawler «Atlantic Navigator» (under the flag of the state of Vanuatu) to krill fishery in APA. For the first time in the history of South Antarctic krill fishery there was a fishing vessel (trawler) equipped with fishing gear and catch-reloading fishing systems without hauling the trawl on deck during a long period of time [10, 11]. First results of the vessel-operation using this new technology appeared impressive. For the fishery season of 2004/2005 F/V «Atlantic Navigator» caught 48 thousand ton of krill. For comparison purposes, the other 8 vessels participating then in the same krill fishery caught about 80 thousand ton all together.

In 2006, the Norwegian supertrawler-factory F/V «Saga Sea» worked in APA for a short period of time (8.8 thousand ton of krill was obtained). In 2007 this «Aker BioMarine» company vessel continued the krill fishery in APA around 7000 to 8000-ton krill meal production. Before putting into operation a second super trawler by the 2010 season, Norwegian krill catch in 2007-2009 will be about 100 to 140 thousand ton a year. Beginning from 2010, it will increase to 200 thousand ton or so.

In the 2005 Scientific Committee of the Commission on Conservation of Antarctic Marine Living Resources, it noted that krill fishery based on continuous pumping (F/V «Saga Sea» procedure), this catch methodology becomes a highly potential risk for the APA marine ecosystem, possibly also related to a higher by-catch of larvae and juvenile fish and krill as compared to trawls of other krill vessels traditionally equipped with normal trawls and gear [11]. In the 2006 Scientific Committee, it admitted that the use of this fishery method creates a series of considerable problems regarding registration of fishery effort, catch, collection of biological data and data on by catch [12].

It is also important to estimate how ecologically-compatible is the possible mass application of organic solvents aboard Norwegian vessels while producing krill oil and its derivative, as it can also have negative consequences for the ecosystem components.

Conclusion

Norway – in the past, one of the leaders of whale-fishery in the Antarctic Region – has not been engaged in krill fishery since 2004. For a long period of time, specialists of the Norwegian company «Aker BioMarine» have studied the market of krill products, development of innovative methods of krill fishery and processing to «appear in the right place at the right time».

The program developed by the company includes the construction of special trawlers, application of new techniques of krill fishery and processing technologies oriented to more valuable and expensive products as compared to those produced by the vessels of other countries. On the whole, the first results of the project implementation appeared successful, at least concerning fishery.

Thus, introduction of the continuous fishing system – fundamentally a new one for krill fishery – onboard Norwegian trawler will substantially promote its catch efficiency. It is now to be seen how soon-to-arrive regulatory aspects will affect it.

However, this new method of krill fishery can and it may indeed have a negative consequence for the pelagian ecosystem of fishery areas, especially when krill catch reaches the volumes planned by the company – 200 thousand ton a year. It is not inconceivable that CCAMLR will be confronted by another problem related to operations of the Norwegian vessels, if it discovers that the technology of raw material processing they use does not guarantee ecological safety of the environment.

A greater debate will surely arise within CCAMLR in particular and the “seafood and fishing community” in general, if other projects at present conclude positively their commercial-scale involvement in this fishery and might also decide to jump onto this business as well. In such case, our catch-effort estimate might fall short. The Antarctic and Southern Ocean Coalition (ASOC)⁶ already estimates the 2007-2008 APA krill fishery fishing notification well above CCAMLR’s precautionary limit; 641.000 for the former against 620.000 annual tons for the latter. It is not hard to understand the enormous pressure and complexities that incumbents, and for sure insurgent companies will face in the coming seasons.

Another even more complex situation is the use of flag-of-convenience trawlers, whereas even non-krill fishing license-approved Norwegian companies have applied through Cook Islands for example. Other owners have applied for krill licenses through the State of Vanuatu. This is the basis of even more pressure on CCAMLR to establish catch limits for small-scale Vanuatu and the Cook Islands. These States are signatories to the CCAMLR convention but are not members of the Commission. This means they do not pay CCAMLR members’ contribution or the additional sum for being a fishing country. Vanuatu has so far shown no interest in joining the CCAMLR Commission, as well as the Cook Islands. It has not followed through with its own enquiry, several years ago, about becoming a Commission member. These two countries could end up taking 40 percent of the krill catch and paying nothing towards its management.

At present, the activity of the «Aker BioMarine» company is mainly oriented to the production of specialized feeds/fodders (on the basis of krill oil and Astaxanthine-antioxidant), intended for sale on commercial fish-farming market. In the future, it plans to master this and other markets – the matter concerns pharmaceutical and food industries and some technical sectors.

Norwegian krill fishery, if it appears a success, can urge other countries towards similar steps. Resources of Antarctic krill become attractive for China, Russia, and other operators and countries with intensively developed aquaculture.

⁶ <http://www.asoc.org/>

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