Technical visit to Japan's Seaweed Industry – specifically focussed on kelp production and large scale processing techniques

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Japan has a total of *6,852 islands, with a population of over 126 million,* extending along the Pacific coast of East Asia. The country, including all of the islands it controls, lies between latitudes 24° and 46°N, and longitudes 122° and 146°E. The main islands, from north to south, are Hokkaido, Honshu, Shikoku and Kyushu, with a total land mass about 5 times that of Ireland.

Travelling with Michael Murphy from Dingle Bay Seaweed (DBS) we visited Honshu (literally Main Island) island. Flying into Tokyo City, we caught the Shinkansen ("bullet train") to Sendai, the capital city of the Miyagi Prefecture and the largest city in the Tōhoku (North Eastern) region which was to be the location of our site visits.

The main focus of the visit was to identify a technique to allow DBS to upscale and speed up the primary processing of their cultivated brown seaweeds, whilst retaining the highest quality, producing seaweed for human consumption. Japan has a long history of seaweed farming and through a good contact we were invited to Japan to see a part of their industry first hand.

In Sendai we were met by our contact, Yoichi Sato, a research engineer from the Riken Food Co. Ltd. who process primarily Wakame (*Undaria pinnatifada*), with annual sales of 80 million USD, employing 271 people.

On the first morning we were taken out to the seaweed farms of Mr Akama (www.kaisounomori.jp), who farms and processes approximately 100 tonnes of different seaweeds, including Wakame and Kombu (*Laminaria japonica*) in Matsushima Bay, this bay is dotted with over 200 islands covered with pine trees and is famed as one of the 'Three Views of Japan'. This sheltered bay is also home to numerous seaweed farmers, including extensive Nori (*Porphyra yezoensis*) production, on nets strung from poles.

Wakame harvesting

Separation of harvest into stipes, frond and sporophyll

Seaweed longlines

The first thing of note was that the longlines were surface mounted, unlike our subsurface lines and that harvesting was more labour intensive with separation of frond, stipe and sporophyll, whilst harvesting.
Secondly the crop was also much heavier than the current Irish harvest, there are definite morphological differences to the 'equivalent' Irish species. Mr Akama also harvests and processes *Sargassum horneri* which grows wild in the bay, catching the crop with a hook on a pole.

Primary processing happens close to the farms, often on the pier. The basic process involves blanching the seaweed and then transferring through 2 ambient seawater baths. After this the seaweed is lightly pressed to remove excess water, salted, left for 1 day and then pressed for another day, after which the seaweed can be sold (shelf life 60 days), further processed or frozen (for storage for up to 3 years).

Blanching and cooling

Transfer to next stage of process

Salting drum

Pressing

From here we visited Riken's central factory in Miyagi (they have one in Iwate and another in Dalian, China). Riken buy blanched and salted product from the farmers and transfer the frozen seaweed to their factories where the seaweed is desalted, washed in artificial seawater, chopped and dried in 2 sequential spiral dryers, operating between 80-120 ^{o}C. Each line can handle 10 tonnes of blanched and salted seaweed per 8 hour shift, with staged machines to remove unwanted substances (grit, metal, plastics etc.).

They produce over 300 tonnes of dried seaweed annually, which is then added to a range of products, their main product is dried and cut Wakame and Wakame soup of which 100 million packets are sold every year. In a meeting with Riken's Manufacturing Director he explained that they developed their first products in 1965 and since then have been expanding production to their current level but believe that now they have saturated their market and are looking to develop new products and market places.

Wakame production is decreasing nationally, mainly due to lack of nutrients and increasing water temperatures and they are working on new temperature tolerant and faster growing strains of Wakame to increase production levels whilst also searching for new areas of production worldwide. Further north we visited Utatsu and Mr Sasaki. Offshore of Utasu they farm 300 longlines, producing over 3000 tonnes annually. Unfortunately the weather was against us and despite our urging they would not go to sea.

Each longline is 150-200m in length, shot approximately 30m apart, held in place with 2 tonne concrete anchors, the equipment looked similar to our own, although we did see pictures of double headrope longlines and grid systems, which we have been working on.

Seaweed boats in Utasu

On the pier in Utasu, Riken have built a new factory which handles 20 tonnes of raw seaweed daily, producing 9 tonnes of blanched and salted product. The farmers harvest the seaweed from 5am and return to shore at 7am, finishing at 1pm throughout the harvesting period February – April. The process was the same as previously seen but just on a larger scale.

Pre-sorted seaweed harvested washed and conveyed into blanching bath

After blanching, it passes through two ambient seawater baths, before light pressing by rollers removes excess seawater

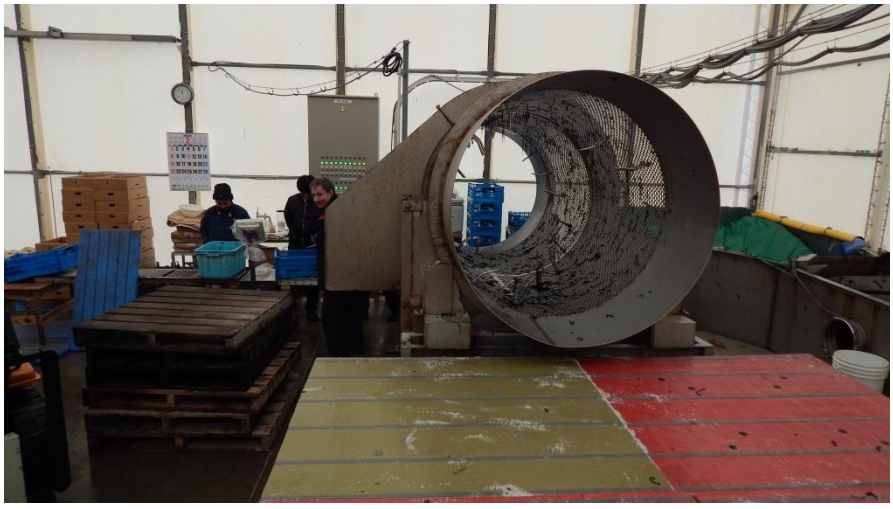
Now salted

Salted seaweed in net bags placed into bagged containers, rested for 24 hrs

Placed into crates

Pressed with weights for another 24 hrs

Desalted



Finished product

This blanched and salted product can then be stored at ambient temperature for transfer or frozen for storage and or further processing. This product can be bought retail in the Japanese supermarkets for about €1/100g packet.

Riken, although not farming directly, support the farmers that they buy from with technical assistance and are involved in an extensive selective breeding programme to identify faster growing and higher temperature tolerant cultivars. Yoichi Sato is managing this project and he took us to two of his laboratories in Sendai (Miyagi Institute of technology) and Kamaishi (Iwate Fisheries Centre).

Storage of gametophytes (Sendai)

Tank trials of cultivars (Kamaishi)

This project is running into its third year and is showing great promise. Riken have offered to help us with technical assistance both from cultivation and processing perspectives and we hope to continue to develop this link. Mr Sato previously spoke at BIM's conference, Irish Seaweed 'An Ocean Wonder Food', last November and his international perspective was well received.

As we travelled we noted large scale building and fortification projects plus ruined buildings from the effects of the 2011 earthquake and subsequent tsunami, the Riken's factory in Sendai had to be completely re-built and a lot of facilities and farms were lost.

Tsunami damaged apartment block

The Japanese people are proud of their own food production, valuing their own above all others and the food we tasted along the way was of outstanding quality, with seaweed playing a role in many of the dishes. Seaweed is part and parcel of everyday life, with a very strong emphasis in the value of seafood in general, the Japanese are noted for their population's health and longevity; we could learn a lot from this Island nation.

Two dishes with seaweed components