

The Potencial of Seaweed Farming in Brazil

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Abstract

According to FAO, Fish States in 2010, volumes of the order of 160,000 tons of *Kappaphycus alvarezii* seaweed were produced, with the main producing countries being the Philippines (89,000 tons), Indonesia (61,000 tons), Malaysia (4,000 ton), Vietnam (2,200 tons), Tanzania (1,500 tons), Kiribati (1,100 tons), China (800 tons) and India (400 tons). In this context, *Kappaphycus alvarezii*, a species cultivated in at least 30 countries, is the main raw material for obtaining kappa I carrageenan, an odorless, tasteless powder widely used in the food and cosmetics industry. In 2017, Brazil imported about 2,500 tons of carrageenan valued at US \$ 22 million. Across the world the main carrageenan producing industries are: FMC BioPolymer, Hercules and Cargill (USA); Shemberg, Marcel (Philippines); Degussa SKW (Germany); CP Kelco (Denmark); Gelymar and Danisco (Chile); Rhodia Food (France) and Ceamsa (Spain). A clone of the *K. alvarezii* macroalgae from Japan was brought in 1995 by USP researcher Edison José de Paula, who introduced it experimentally in Ubatuba Island, north coast of São Paulo. The introduction of a species from another country was a response to the lack of native algae that was economically viable for mariculture. Since then, this species has proved to be an excellent choice because it is easy-to-use and reproductive seaweed, a high daily growth rate, attractive market value, direct employment generation and an increase in family income, guaranteed sales in the national market, besides the potential of commercialization with other countries that import large volumes of this species.

Keywords: Mariculture; Seaweed Seeweed farming Commercialization

Introduction

A clone of the *K. alvarezii* macroalgae from Japan was brought in 1995 by USP researcher Edison José de Paula, who introduced it experimentally in Ubatuba Island, north coast of São Paulo. The introduction of a species from another country was a response to the lack of native algae that was economically viable for mariculture. Since then, this species has proved to be an excellent choice because it is easy-to-use and reproductive seaweed, a high daily growth rate, attractive market value, direct employment generation and an increase in family income, guaranteed sales in the national market, besides the potential of

commercialization with other countries that import large volumes of this species (Figure 1-2).

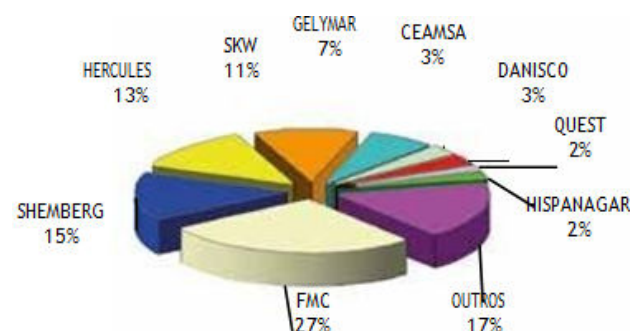


Figure 1: Worldwide carrageenan production by company.

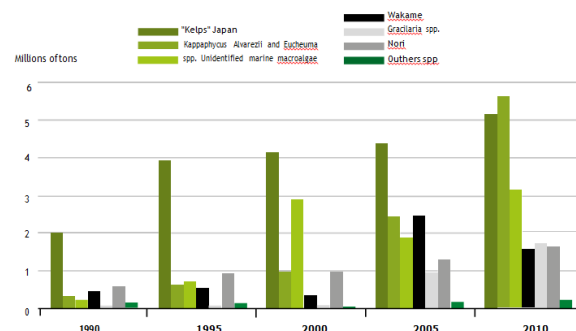


Figure 2: Production of macroalgae cultivated worldwide by species group.

After a few years, in 1998, a second Venezuelan clone of *K. alvarezii* was introduced experimentally in Ilha Grande Bay, by the Marine Biologist Miguel Sepulveda in south coast of the State of Rio de Janeiro, with the objective of testing the viability of mariculture in commercial scale, using a special prototype of "Culture Raft". From then on, we saw the expansion of farming in Ilha Grande Bay, culminating in the emergence of the Sete Ondas Biomar Company, which, although now extinct, had an important role to leverage the activity, maintaining for a few years a production with 100 cultivation rafts in the region of Marambaia (RJ). The SEAWEED FARMING in Ilha Grande Bay was supported by the Ministry of Fisheries and Aquaculture (MPA), by IBAMA and by researchers from various institutions, who stimulated and collaborated with the regulation of the activity. In 2008, after several environmental studies of universities and

institutes, Normative Instruction No. 185 Brazilian Institute of Environment (IBAMA), was published in the Official Daily of the Union, authorizing and regulating the cultivation of the macroalgae *K. alvarezii* in the area between the Bay of Sepetiba (RJ) and Ilha Bela (SP).

In the littoral of Santa Catarina, south of Brazil, the potential of the mariculture of this species has already been very promising and this year is expected a release of IBAMA for the implantation of commercial farms. The studies carried out by researchers from UFSC and EPAGRI showed that the Santa Catarina coast has areas with potential to produce about 730 tons of dry seaweed per year. In addition, there are technical indicators of productivity of the *K. alvarezii* cultivation in consortium with molluscs grown in this region, which further increases the success of the activity.

In the north coast of the State of São Paulo, some producers are still struggling to expand their crops. Obstacles are due the lack of an Environmental Management Plan within the APAMLN (Marine Environmental Protection Area of the North Coast), which has made it difficult to expand the cultivation of this species in the region. Nevertheless, researchers from the Fisheries Institute together with a group called Mariculture GT, are engaged in regulating this activity with IBAMA.

In 2013, a doctoral thesis conducted in Oceanography of the Federal University of Pernambuco, aimed to evaluate the cultivation of *Kappaphycus* introduced in the early 2000th in the state of Paraíba and has been cultivated by fishermen in an artisanal scale, generating questions about the risk of environmental invasion to the local ecosystem. The results of the study, however, showed that, to date, there is no establishment of *K. alvarezii* in the north coast of Paraíba, and the invasion potential of the species considered very low for the region, although there is a recommendation for the continuity of actions environmental monitoring in the area under cultivation. The theme is controversial, but we must not forget the enormous potential for the cultivation of *Kappaphycus* in the northeast coast. It is also worth mentioning that after four decades of successful introductions with *K. alvarezii* in several countries, few cases of effective establishment of introduced algae stem were actually proven.

Startle reflex Production, profitability and technical aspects

The species *K. alvarezii* requires some favorable conditions for its cultivation, such as protected bays of strong waves and average depth of 0.50 m, hot water (above 20°C), good luminosity and salinity above 20 ppm. Its cultivation does not require high technology and can be started with relatively low investment, which greatly facilitates the expansion of activity. In addition, it is worth mentioning that the producer, to begin his cultivation, acquires only some kilos of seedlings. After that the propagation of the seedlings is only vegetative and not necessary buy new seedlings, just only maintain a stock for replanting. In Brazil, the seaweed farming method structure, better known as a "Raft Culture", is composed of a set of PVC pipes with a diameter of 100 mm and 3 meters in length, sealed

at their ends, functioning as floats connected to each other by means of 8 mm polypropylene cables. The Raft has a dimension of 150 m x 3 m (450 m²) and is anchored at its ends by means of iron stakes buried in the bottom or concrete cement block. On average, one Raft can produce 7 tons of live algae every 50 days, up to 8 tons in summer, depending on the place of cultivation and other factors such as algal density / m², water temperature, salinity, luminosity and herbivory. These values are crude, since during the harvest, 20% of the algae must be separated for new replanting seedlings. The cost of each Raft of 450 m² – is around USD 1.00.00. Per hectare, we can consider an average load capacity of 15 Rafts, since the good navigability conditions of boats and canoes in the cultivation area must be taken into account, as well as movements of ferry movements in the local stream regimes. The number of people operating in the Farming should also be taken into account, and it is estimated that four people can operate on handling 1 hectare (**Figure 3**).



Figure 3: Model of standard of Raft Cultivation used in Brazil.

Traditionally, the most widely used cultivation or propagation technique in the world for cultivating *Kappaphycus* is to cut 100 g algae branches and tie in small cables known as "Tie-tie", which are placed in lines with spacing of 20 cm apart, being soon after, fixed in stakes in the substrate, in a depth of a maximum of 1 meter. This method, known as "Stake Cultivating" or "Bottom Monolines", is limited to low depth regions, enabling the farmer to easily manage the crop. The technique can also be used in Raft systems or long lines. Another cultivation technique known as "Tubular Net" was introduced in Brazil by businessman Mr. Alexandre Feder from AlgasBras Company (Brasil-RJ) in 2005, after a visit to some Farms in the Philippines where this method was used. Simple and easy to handle, it consists in placing the algae seedlings (100 g) in a tubular net (net used for the cultivation of mussels) with 5 meters in length, with the aid of a PVC pipe of 75 mm. Then the nets are stretched in the modules of the Cultivation Raft close to the surface. Nowadays it has been the most used method due to the fastness to the planting and the facility to harvest. Currently, the Brazilian scenario of *Kappaphycus* cultivation in the only belt released by IBAMA (between the Bay of Sepetiba-RJ and Ilha Bela-SP) can still be considered incipient, even after eight years of its release. However, we can consider as quite promising the efforts that

have been made, for years, by some entrepreneurs. As a result, there are currently two commercial crops in the region of Paraty - RJ and three in Ilha Grande - RJ. The production of these projects is directed to the company Algasbras

Rio de Janeiro, which has been playing an important role in the development of the activity in recent years. This company has its facilities dedicated to the processing of seaweeds in order to produce kappa carrageenan, a product that is traded on the national market. For this, it buys all the fresh production of the region, besides having its own seedling in the region of Itacuruça. According to the director of the company, Alexandre Feder, in 2017 were bought and processed about 500 fresh tons of seaweeds, and producers are paid the amount of R \$ 0.45 kilo of fresh seaweeds, and Algasbras company is responsible for logistical support to the factory. By 2019, the company intends to initially promote the cultivation of algae for 10 families of artisanal fishermen in the Ilha Grande Bay region, with a forecast of reaching a production of 1,000 tons of fresh seaweeds in order to supply the factory every month.

Another Brazilian company, Agar Gel located in João Pessoa - PB, also processes *K.alvarezii* to obtain Carrageenan. This demand means another alternative for the production of the South and Southeast regions. Another perspective to be evaluated would be to export Brazilian production to nearby countries such as Chile and Argentina, which have processing factories such as Gelymar and Soriano S.A. These companies import more than 100 tonnes per month of dry *Kappaphycus*, at prices ranging from 2 to 4 dollars per kilo.

Seaweed Farming in other countries (South and Central America)

In addition to the Asian countries already mentioned, *K. alvarezii* seaweed has also been grown in Panama, Ecuador, Santa Lucia, Belize, San Vicente, Trinidad Tobago, the Grenadines and Mexico, although production in these countries is still small. The crops are familiar and the production is processed locally or exported. The governments of these countries have supported the activity with incentive programs for cultivation and technical training.

In Ecuador the seaweed *Kappaphycus* was introduced in 2011 by the Brazilian company Seaweed Consulting to be experimentally farmed with *Litopenaeus vannamei* shrimp farms. The results were very positive, showing a great potential of this species for the polyculture. Currently, two shrimp farms are producing *Kappaphycus* with the "Stake Farming" or "Monolines" system, and the Equatorian government is promoting its cultivation at sea through a local cooperative of artisanal fishermen (FENACOPEC). In Panama the company "Gracilarias de Panamá S.A" produces and promotes the cultivation of *Kappaphycus* for local fishermen, exporting all their production. In Mexico, since 1990, the government has supported experimental crops in the Yucatan peninsula as an alternative to some local communities. As a result, the annual Mexican production of *Kappaphycus* is 200 tons of dried seaweed. In addition to being an attractive business option,

seaweed farming also contributes to poverty reduction through the generation of jobs and income, also contributing to the establishment of traditional communities in their places of origin. Efforts have been directed at establishing clear rules in relation to environmental licensing and in the areas in government waters. Experience has been shared by a number of international institutions and experts in the past 30 years for a successful commercial seaweed cultivation program to take into account the following aspects (**Figure 4**).



Figure 4: *K.alvarezii* cultivation in shrimp farms in Ecuador.

Conclusion

Availability of the economic resources necessary for the operation of the program to reach commercial volumes, Design management and competent execution of the project. This last point includes the linkage of technical and professional staff to field workers, as well as the adequate identification of the barriers that impede the entry of farmers into commercial activity and the development of strategies to overcome them. The appropriate selection of suitable places for the establishment of crops, in order to guarantee the success of the program in the community and justify the investment of time, effort and resources. Clear and precise identification of the main constraints that have the members of the communities to join the project (investment capital for seedlings, training and technical assistance, business organization, basic services, etc.) Enough seedlings available and adapt to local ecological and environmental conditions, as the cultivation systems to be employed. In addition, *Kappaphycus* algae must synthesize high quality carrageenan of commercial interest. Technical assistance and permanent business partner, from the installation of the crops to their commercial phase, including the subsequent follow up that guarantees the sustainable production of raw material, generating sufficient income to meet the demands and socioeconomic needs of the farmers. Guarantee the marketing to producers with fair and competitive prices through long-term purchase and sale agreements. Creation of a healthy and agreeable work environment with safety and hygiene conditions that allow the permanent motivation of the farmers and their families. The incorporation of women and young people, offering tools for their integration, since they are generally the margin of productive activities in most of the coastal communities of the country. Thus, all these ingredients and the experiences that can be achieved in the near future through a community organization will serve as a fundamental basis for the sustainable development of *Kappaphycus* farming, causing a very positive socioeconomic impact in several regions of the Brazilian coast.