Processing Swimming Crab Shell into Value-Added Products: It Utilization as a Calcium Source Flour and Flavoring

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Abstract. Indonesia as a maritime country has abundant marine resources. Indonesia's fisheries sector has significantly contributed to the world's food needs. Processed swimming crabs and swimming crab products are one of Indonesia's most important exports. Swimming crabs are generally exported fresh, frozen, or canned. The use of swimming crabs is only for the part that can be consumed, namely the meat. Swimming crab shells have the potential to pollute the environment. In addition, several countries have implemented regulations regarding environmental sustainability requirements in achieving the Sustainable Development Goals (SDGs) with one of the programs related to zero waste products and environmentally friendly processes. The utilization of swimming crab shell waste is not optimal as organic fertilizer, feeds fish, chitin, and chitosan. This floating crab shell trash may be used to make useful items including calcium source flour, stuffed crab shells, crab broth, seasoning powder, umami flavor enhancer powder and seafood seasoning flour. This article investigates the possibility of crab waste as a food product with a range of processing options with a selling value. This study provides a solid foundation for expanding awareness of environmental challenges and the socioeconomic benefits of waste management.

Keywords: Swimming crab shell · food waste · value-added products · calcium source flour · flavoring

1 Introduction

Indonesia as a maritime country has abundant marine resources both in number and diversity. Therefore, the fisheries industry is expected to continue to grow and significantly contribute as a driver of the national economy. So far, Indonesian fisheries have contributed significantly to the world's food needs. Indonesia exports various types of marine products such as tuna, skipjack, shrimp, and crab to various parts of the world. Processed crabs and crab products are one of Indonesia's most important exports. According to the Ministry of Maritime Affairs and Fisheries in the span of 5 years, the value of crab exports from year to year is increasing by an average of 4% annually (KKP 2017; KKP 2022).

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Swimming crab are generally exported in fresh, frozen, or canned form. Based on data from UN Comtrade (2022), Indonesia's blue swimming crab exports in 2021 amounted to 15,090 tons with an export value of $99 million. The use of the swimming crab is only on the part that can be consumed, namely the meat. According to Multazam (2022), one swimming crab produces process waste consisting of 57% shell, 3% body reject, and 20% boiled water. So based on previous export data, there are 8,601 tons of swimming crab shells that are not utilized and have the potential to pollute the environment. In addition, several countries have implemented regulations regarding environmental sustainability requirements in achieving the Sustainable Development Goals (SDGs) with one of the programs related to zero waste products and environmentally friendly processes. As a result, environmental sustainability criteria are becoming more stringent and will become a major problem. The Indonesian crab industry's sustainability and development are dependent on sustainable resources (Yusuf & Trondsen, 2014; Yusuf et al., 2018). Therefore, the utilization of swimming crab shell waste is a solution to tackling the problem of environmental pollution and one of the efforts to reduce the increasing volume of waste.

Utilization of this swimming crab shell waste is generally used as organic fertilizer so that it can reduce the occurrence of pollution to the environment caused by this pile of swimming crab shells. Apart from being an organic fertilizer, shell waste can also be used as fish feed, chitin, and chitosan. However, the utilization of this swimming crab shell waste could be more optimal. Multazam (2002) stated that the swimming crab shell waste and the rest of the meat still attached to the shell contain protein, fat, pigment, calcium salt, chitin, crude fiber, and minerals including phosphorus and calcium. So that the swimming crab shells can be used by processing into flour for fortification of various food products. Based on the analysis of Yonata et al., (2021) reported that swimming crab shell waste contains 1150 mg/100 of glutamic acid. Therefore, this swimming crab shell waste is potentially a raw material for flavor production. Utilization of swimming crab shell waste as the flavor can be in the form of products such as crab broth, seasoning powder, umami flavor enhancer powder and seafood flavor flour (Yusuf, 2021; Hastuti et al., 2012; Faruqi, 2020).

This article investigates the possibility of swimming crab excrement as a food product with various types of processing and selling value. The emphasis is on implementing waste innovation and marketing it; this study provides an important basis for entrepreneurs and governments to increase their attention to environmental concerns as well as the social and economic benefits of waste management.

2 Methodology

This study is intended to provide a business framework for discovering entrepreneurial prospects through innovation, as well as to assess the potential of new entrepreneurs through innovation and adaptation to the business environment. In general, the procedure involves the following steps:

1. Observation phase of processed swimming crab shell products, this process examines processed swimming crab shells into various kinds of food products in research that has been reported in previous studies.

2. Reviewing the market potential for the development of processed swimming crab shell products.

3 Result and Discussion

Processed swimming crab shell products can be utilized in a variety of food products. Some of the uses of swimming crab shells are shown in Table 1:

Swimming Crab Flour as a Source of Calcium
Swimming crab shells contain minerals calcium (Ca) and phosphorus (P) with levels of 19.97% and 1.81%, respectively so they can be a potential source of calcium (Multazam, 2002). Calcium is a mineral needed by the body in amounts of more than 100 mg per day. The function of calcium in the body is for the growth and development of bones and teeth, regulating muscle reactions and minerals that affect body growth (Guthrie, 1975; Almatsier, 2003). Lack of calcium intake in the human body causes metabolic abnormalities, especially at an early age, growth disorders such as weak bones, easy to bend and brittle. Adults over 50 years old will lose calcium from the bones so that they become brittle and break easily known as osteoporosis (Ensminger et al., 1995; Almatsier, 2003). The flouring process can maintain the calcium content of the swimming crab shells. Based on research by Rochima (2005), the analysis of swimming crab waste flour showed calcium levels of 14.87%. According to Hadiwiyoto (1993) one of the alternative efforts to utilize swimming crab shell waste in order to have the value and usability of swimming crab waste into products of high economic value is processing into swimming crab shell flour which can then be processed as a substitute for food ingredients, for example crackers (Yanuar et al., 2009). The process of making swimming crab shell flour can be done with the following grooves Fig. 1.

Swimming Crab as a Flavoring
Swimming crab shells are high in glutamic acid and disodium 5' ribonucleotide, both of

Table 1. Processed products swimming crab shell

Author	Processed products
Yanuar, 2013	Utilization of swimming crab shell waste as a source of calcium in the form of flour provides convenience to the community in meeting needs of calcium intake, The calcium yield obtained in crab shell flour is 300.90 mg/g
Yusuf, 2021	The creation of new goods based on swimming crab waste, such as seasoning powder, umami flavor enhancer flour, and seafood flavor flour, poses new change for business people. Waste that has no economic worth at first can be turned into a valuable business opportunity.
Raab & Mayer, 2007	Utilization of swimming crab shell waste into stuffed crab to reduce food waste
Hastuti et al., 2012	The boiled water of the swimming shell has a very strong taste and smell of the crab so that crab shell broth has the potential to be used as flavor

which are umami compound sources (Tu et al., 2020). This compound is a high-potential compound found in swimming crab shells. Swimming crab shells may be controlled and turned into a variety of food products in addition to being used as an element in feed. Crab by-products may be used to make high-value goods such as crab soup, seasoning powder, umami flavoring powder, seafood flavored flour, and stuffed crabs. The following grooves can be used to make swimming crab shell as flavour Fig. 1.

The first use of swimming crab shells as a flavoring is stuffed crab shells. Using real swimming crab shells as a container in processed products adds to the taste of the food because the shell has flavoring components as described previously. The main markets for frozen stuffed crab products are developed countries such as Japan, USA, and several European countries. Until now, India has been the main exporter of stuffed crab to these countries (Rajamohan & Jedaburai, 2014). However, it is hoped that in the next few years Indonesia can compete with India as an exporting country because of the abundant sources of swimming crab shells and easy processing.

It is also used as a seasoning powder. The process of producing swimming crab shell flour has been published in several publications. Yonata et al., (2021) completely discussed the technique for generating swimming crab flour in their latest work. Cleaning, drying, grinding, and sifting are all required steps. The swimming crab shells are washed under running water, then cooked for up to 5 min in boiling water, and then drained. The clean swimming crab shells were dried at 50 °C for 4 h before being ground into a powder with a disk mill. To produce a uniform size distribution, sift the flour with a 100-mesh sieve. Swimming crab shell flour is now ready to be developed into a range of culinary additions, notably as an umami source in food seasonings.

The next use is broth. The broth is made by boiling the swimming crab shells. The boiled water of the swimming crab shell has a very strong aroma and taste of the swimming crab so this boiled water has the potential to be used as a flavor or flavoring (Faruqi, 2020). However, using swimming crab shells as broth still has limitations, namely the product's short shelf life. Therefore, further processing is needed such as the encapsulation process. The transformation of crab excrement into umami goods has great promise. The distinct perfume of seafood coupled with salt, sugar, pepper, and local spices yields a variety of spices with a very strong local flavor that is well received by the community (Yusuf, 2021).

Swimming crab shells' business potential as a flavour has gained attention in recent years. This is owing to the shift in flavoring source to natural components. According to Radam et al. (2010), demand and consumption of "Non MSG" products in Malaysia are high and will continue to climb; the current trend also encourages Malaysian food manufacturers to seek for umami-source items that do not contain MSG. This predicament is aggravated by the fact that MSG is generally disliked by customers in the United States. However, because this country has a high demand for umami sources, umami extract from natural sources is the greatest alternative to MSG (Wang & Adhikari, 2018). Globally, there is a significant need for umami ingredients, thus swimming crab shell seasoning goods have a great chance. The product's selling value will rise if it is further processed into seasoning items. This practice also helps to protect the fisheries ecosystem (Yusuf, 2021).

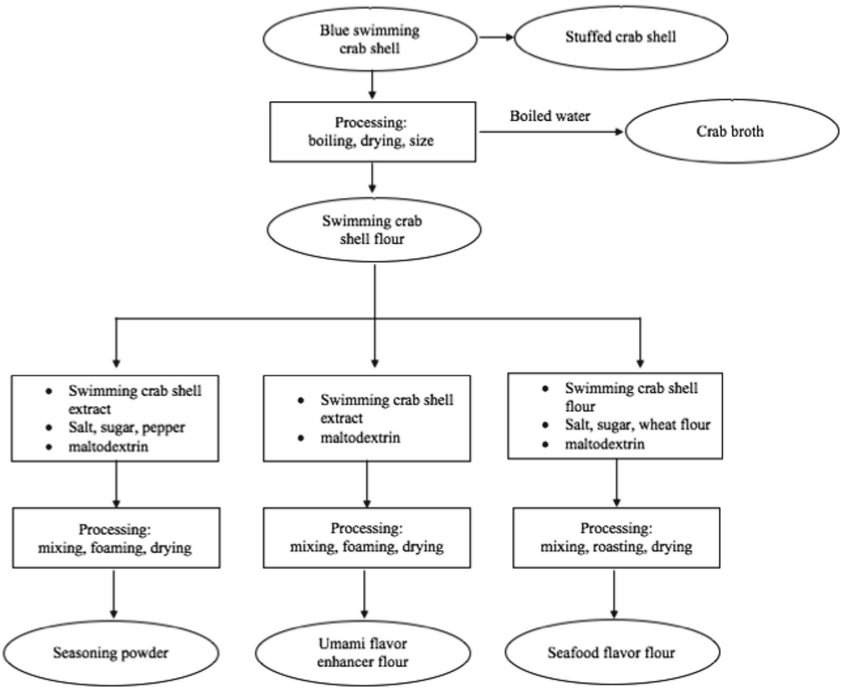

Fig. 1. Flow Chart of Processed Based on Crab shell waste

4 Conclusion

In Indonesia, the development of new items based on organic waste presents new challenges for businesspeople; rubbish with little economic value at first might become a profitable commercial opportunity. On the one hand, this strategy has a positive impact on environmental rehabilitation, which has been an issue for the fishing sector. The process of transferring technologies and commercializing scientific discoveries must be improved so that rubbish may be converted into healthy, safe, and delicious food. This research contributes to the solution of the problem of crab shell waste as a viable calcium flour and source of umami cuisine for human consumption.

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AUthor's Contribution. All authors contributed to the design and implementation of the research, to the analysis of the results and to the writing of the manuscript.

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