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TIME SUBMITTED	11-MAR-2019 05:28AM (UTC+0700)	WORD COUNT	2467
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IOP Conference Series: Earth and Environmental Science

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IOP Conf. Series: Earth and Environmental Science **157** (2018) 012056 doi:10.1088/1755-1315/157/1/012056

Indonesian jellyfish as potential for raw materials of food and drug

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Abstract. Jellyfish used to be considered as a pest of fish and a nuisance to fishing operations. Yet, forty years ago this jellyfish was found to be materials of food, medicine and cosmetics and the utilization of jellyfish is now familiar in Indonesia after being imported by China and Japan industry. This study aims to determine the potential development of jellyfish commodities as food and drugs from Indonesia with the target to improve the welfare of fishermen. This research used methods of rapid observation, limited interview, processing with immersion experiment and desiccation. In addition, various literatures were also used to enrich the knowledge about jellyfish business. Observation showed that the appearance of jellyfish in Indonesian waters varies based on the fertility of the waters affected by oceanographic conditions. Jellyfish contains low calorie and fat content, high protein and minerals as well as total collagen. Thus, jellyfish is a nutritious food source to be developed into food supplements, nutricosmetics and functional foods. Due to its large size, the jellyfish from Bunyu Island is more viable than jellyfish from Suppa Pinrang to be exported as raw material. Therefore, the manufacture of food and medicines from jellyfish materials is possible to be done in Indonesia.

1. Introduction

Jellyfish contains many essential substances beneficial as raw material for food, cosmetics and drugs. For that feature, countries such as China and Japan are until now still importing semidried jellyfish from other country, where Indonesia served as one of jellyfish exporters in South East Asia. A high demand of annually tens or even hundreds of tones from various regions in Indonesia is recognized. It is noticed that until several years ago Japan imported 5,400-10,000 tones of jellyfish products annually [1].

Due to its higher protein quality and low calorie, jellyfish is a nutritional food source to be developed as supplementary diet, nutricosmetics and functional foods [2]. The potential development of jellyfish is quite high, however, the knowledge on its distribution and economical value is still limited due to research on jellyfish in Indonesia is yet to be developed. The distribution of jellyfish potential is only acknowledged when there is the utilization (catching and processing) by the community in specific location. On the other hand, ecologically the availability of jellyfish is relevant with wet season [1]. This in turn restricted the utilization and the annual availability of jellyfish raw material.

Jellyfish is either on the third and or fourth level of marine ecosystem food chain. As the third level, jellyfish feed on zooplankton or microorganism, whereas as the fourth level, a big size jellyfish diet beside zooplankton include larvae, juvenile or even pelagic breed. Provided this ecological process is sustainable, a high number of big fish population will disappear, which will reduce the fisheries productivity *in situ*, thus the fishermen income will be reduced as the population of adult fish decline. It can be predicted that when millions of jellyfish in the waters become pest to any fish larvae and juveniles [2] the fishermen will suffer much loss as the fish catch declined. Fishermen could not even go fishing as jellyfish get into their fishing nets.

Finally, since the end of the 1980ies jellyfish became the alternative source of income other than fish. Therefore, the utilization of abundant jellyfish became the main target to meet the international market demand. The utilization of jellyfish becomes a new model in increasing fisheries economy. However, the constraint of semidried processing with still higher cost that takes quite a long time (30 days) and lack of hygiene - bacteria contaminated resulted in low product quality. This research aimed to create potential in the utilization of jellyfish from various regions in Indonesia by modeling an efficient and cheap jellyfish processing to be an internationally marketable product. This paper is part of our proposal submit with the same theme of '*Transforming a marine nuisance into an asset: using jellyfish to improve health and the economy in Indonesia'*.

2. The Utilization of Jellyfish Indonesia

The abundance period of jellyfish is varied on oceanographic conditions [3] and the waters fertility. Jellyfish is distributed in various locations especially at the bays and in the waters which often with higher eutrophication as well as higher pelagic fish stock [4]. The list of location in the table 1 below presents a very high abundance of jellyfish. Several locations were recorded [1] *i.e.* in Kalimantan Island of South and East Kalimantan, in Halmahera of Bacan Island, and generally in West Java coast and Sumatera Island of Medan and Bangka Island.

Presently there are 13 points of jellyfish utilization in Indonesia which spread out from the Island of Sumatera, Java, Kalimantan, Sulawesi, Nusa Tenggara and North Moluccas (figure 1 and table 1). There has not been any information on the distribution of jellyfish utilization in the larger area other than those mentioned above. For example in the whole coasts of Papua, East Nusa Tenggara, Central and West Kalimantan, Central and North Sulawesi are estimated to possess the water characteristics suitable for jellyfish that served as a potential new development location of jellyfish utilization.

The jellyfish is generally available in the dry season toward and during the wet season. This is as at that time the waters condition is undergoing an eutrophication during the monsoon except in areas where upwelling occurs on the dry season. Several species of jellyfish simultaneously occurred in the time range of August-November and some occurred almost the whole year from May to December depends on the season, type, and location as well as eutrophication condition [1]. In around Kalimantan jellyfish occurred from August, which also occurred in part of West Java and in Central Java, while in Nusa Tenggara it occurred in this October. In July jellyfish occurred in Halmahera, Muncar of West Java and Medan of Sumatera (table 1).

Figure 1. Location of jellyfish utilization in Indonesia

Tabel 1. Distribution of utilization location, month and season of jellyfish abundance in Indonesia

Specific Location	Region	Time of Abundance	Seasons
Bay of Cempi,	Sumbawa Island	October-December	Wet
Bay of Saleh,	Sumbawa Island	October-February	Wet
Bunyu Island Tarakan	North Borneo	August-January	Dry-Wet
Sebatik Island	North Borneo	August -January	Dry-Wet
Coastal of Balikpapan	East Borneo*	August -November	Dry-Wet
Kota Baru	South Borneo*	August -November	Dry-Wet
Bacan Island	Halmahera*	July-August	Wet
Coastal of Tuban	East Java*	March-May Sept-November	Dry-Wet
Coastal of Cirebon	West Java*	August -November	Dry-Wet
Coastal of Muncar	West Java *	July-November	Dry-Wet
Coastal of Cilacap	Central Java*	August-November	Dry-Wet
Coastal of Medan	Sumatra*	June-November	Dry-Wet
Coastal of Bangka	Sumatra	No data	No data

Note: * locations were as recorded by Omori and Nakano (2001)

3. Physical Characteristics

The jellyfish were sampled from two locations, i.e. Tanjung Suppa waters of Pinrang Regency in South Sulawesi Province and Bunyu Island of Tarakan Regency in North Kalimantan Province. All samples show linear relation between weight and jellyfish umbrella diameter with linear equation as $Y = 0.011x - 13.39$, with correlation strength (R^2) of 90 percent. However, those two jellyfish samples were different in size, both in diameter and weight. Samples from Pinrang waters were smaller with 9-12.5 cm diameters and weight of 1800-3200 gram. While samples from Bunyu Island waters were bigger with umbrella diameters of 31-53 cm and weighted between 3400 and 6200 gram (figure 2).

Further, jellyfish samples from Bunyu Island were more suitable to be utilized as raw material according to the jellyfish business required criteria. The jellyfish being traded are those with minimum size of 30 cm in diameter. Thus, the jellyfish from Suppa Pinrang can not be utilized as export commodity due to their small size. It should be noted though that those two jellyfish samples from the waters of Bunyu Island and Suppa Pinrang were of different species.

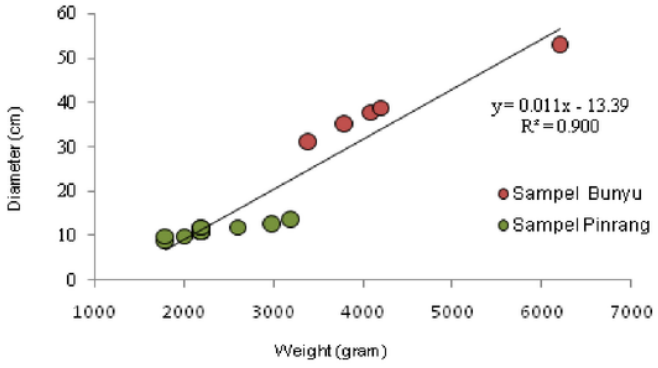

Figure 2. Correlation between umbrella diameter and weight of jellyfish

4. Processing

The processing of raw jellyfish to be a half-ready product should be carefully done so as not reducing its chemical content [5]. The jellyfish umbrella should be simply processed to get a semidried raw material. The jellyfish are soaked in a mixture of salt and alum for 30 days which show positive result of elastic and firm jellyfish texture. The remained mixture of alum and salt are cleansed and dried using controlled media of modified wood oven box with a controlled temperature. Kogov *et al*. [6] compared several methods used for the study of jellyfish biochemical composition and found that during drying in the oven at 60°C, the content of C, N and the total content of amino acids in the jellyfish tissue decreases 10 times as compared with cool dehumidification [5, 6].

5. Proximate and Micromineral Content

In three jellyfish species, *Acromitus hardenbergi*, *Rhopilema hispidum* and *Rhopilema esculentum,* it was found that especially for parts of umbrella (cup) and arm also mouth contain the proximate composition of calorific value, collagen content, amino acid profile, chemical score and elemental constituent [3]. Other research [7] measured the chemical content of the moon jelly *Aurelia aurita.* Generally all jellyfish contain low calorie and fat, high protein and mineral, as well as the total collagen (table 2).

Tabel 2. Chemical composition of the moon jelly*Aurelia aurita* [7].

Proximate parameters	Content (%) in dry weight
Water Content	68,67
Ash Content	12,81
Protein Content	11,09
Fat Content	0,30
Carbohydrate	7,13
Micro Mineral	**Content (ppm) in dry weight**
Calcium (Ca)	11,1
Magnesium (Mg)	3652,6
Natrium (na)	111209,4
Kalium (K)	2959

The proximate content of the river jellyfish *Acromitus hardenbergi*, the sand jellyfish *Rhopilema hispidum* and the red jellyfish *Rhopilema esculentum* [3] are 1.0-4.9 kcal/gram; fat 0.4-1.8%; protein 20-53.9%; mineral 15.9-57.2 %; collagen 122.64 – 693.92 mg/g in dry weight. Moreover the dominant amino acids in the jellyfish umbrella and tentacle are glycine, glutamate, threonine, proline, aspartate and arginine, while the major elements are sodium, potassium, chlorine, magnesium, sulphur, zinc and silicon. As it contains higher protein quality, low calorie, jellyfish is a nutritious food source to be developed into supplementary food, nutricosmetics and functional foods [3]. High collagen content that is the protein contained in the body which play important role in the stamina and in building the tissue are bone, tooth, joint, muscle and skin. Acid amino content give various important use to the body.

6. Jellyfish Market Development

Jellyfish fishing in various countries is millions of dollar business. Its annual trade value of 25.5 US million dollars is accounted from the Philippines, Vietnam, Thailand, Malaysia, Indonesia, Singapore and Myanmar. This effort really helps the fishermen and businessmen as well as the state in increasing their fisheries industry income. The biggest importers are China and Japan, but in 2001 Japan is more dominant by 50% of the world jellyfish [1]. The market price varies on the population size and condition. The larger the jellyfish, the better is the price. The jellyfish with higher stinger force is

cheaper while the regular umbrella shape is more expensive. The wholesale price of A premium grade jellyfish umbrella in Asia is USD $ 10.00-12.00 per pound, with minimum diameter of 18 inches and its color should be white to creamy, and at the same time it is of crispy texture yet tender [8].

Potential of jellyfish business in Indonesia is more developed as the eutrophication potential of waters in the coastal and bay regions are high. This is supported by the labor intensive fishermen working system and skilled labor is needed to increase processing quality. Thus the semidried jellyfish product can be accepted by the international market. However, processing study is required to make new processed product of raw jellyfish to satisfy Indonesia's food and cosmetics industries.

Acknowledgments
We wishing to acknowledge to Maulida Suaeb, Urfan, Winwien, Ferdinan, Syahrullah, who were active in this jellyfish research and sampling in Bunyu and Pinrang.

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PRIMARY SOURCES

1	Yuferova, Aleksandra Aleksandrovna. "The Impact of Different Drying Modes of Scyphozoan Jellyfish Rhopilema Esculentum and Aurelia Aurita on the Protein and Carbohydrate Components in their Composition and the Possibility of Their Use as Dried Prepared Food : IMPACT OF DIFFERENT DRYING MODES ON SCYPHOZOAN JELLYFISH", Journal of Food Process Engineering, 2015. Publication	%2
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