Ethnobotany study of Jalawure (*Tacca leontopetaloides*) as a source of nutrition quality improvement on the South Coastal people in West Java

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Abstract. Community income of West Java coastal areas ranging from Pelabuhan Ratu area to the coastal area of Leuwung Sancang in South Garut, West Java is fishing. Their daily life is very dependent on the results of fishing in the sea. Livelihoods like this are highly dependent on the condition of the seasons. This makes the life of coastal communities is often categorized as food insecure communities. The longer dry season than the rainy season adds to the livelihood of the community tends to suffer from food insecurity. *Jalawure* (*Tacca leontopetaloides*) is one of the plant species that grows on the coast, has tubers containing a high source of carbohydrates and mineral content which can be utilized by the community to overcome such dry conditions. This research was conducted from 2016-2018 in several villages, namely the coast of Kerta Jaya Village (Sukabumi Regency), Cidamar (Cianjur Selatan, Cianjur Regency), Cikelet, Cijambe, Cigadog, Mancagahar, Pameungpeuk, Leuwung Sancang (Garut Regency), West Java. Ethnobotany study of *Jalawure* is discussed in this manuscript.

1. Introduction

Indonesia is one of the ten most disaster-prone countries in the world based on research from the Center for Research on the Epidemiology of Disaster (CRED) FSVA 2015. In 2012 and 2013, there were 15,432 disasters took place and the most frequently affected provinces were West Java, Central Java, and East Java, especially disasters caused by hurricanes, floods, landslides and droughts. Indonesia not only faces large scale and sudden disasters, but also disasters that can be predicted due to climate change. This climate change poses a big threat to food and nutrition security, especially for households that are highly dependent on livelihoods as fishermen and agriculture. The uncertain climate, rainfall deviations, increased risk of plant pests have a negative impact on farmers, making it difficult to determine the agricultural calendar and have an impact on decreasing production and productivity of crops which can ultimately threaten the livelihoods of farmers as a whole.

Climate change can be seen from various natural phenomena which are increasingly taking place today such as increasing irregular air temperature and season, high rainfall intensity, and floods. Based on the results of the 5th Intergovernmental Panel on Climate Change (IPCC) report in 2014 which stating that temperatures have risen by about 0.8 °C and there will be an average temperature increase of 3 °C -5 °C at the end of this century which has resulted in destruction diverse of flora and fauna species. Meanwhile, as much as 3% of carbon dioxide produced through human activities is absorbed.
by the sea, resulting in ocean acidity and an increase in sea temperatures which causes a reduction in fish populations and further catchment areas. Global warming has also caused a degradation in coastal and marine ecosystems that will have an impact on people's welfare.

The South Coast of West Java starting from Sukabumi Regency, Cianjur Regency, and Garut Regency, is an area whose main livelihood is sea fishing. Fishermen are currently having difficulty finding fishing locations, due to poor sea conditions such as existing of storms and tidal waves in the middle of the sea. The uncertain season conditions are very influential on the lives of fishermen households, especially their main livelihood depends on the sea. So that some fishermen are unemployed who do not have a livelihood, and do not have other skills. Things like this can lead to food shortages and will lead to food insecurity.

The decline in production and productivity of fishermen has resulted in reducing income so much, so that declining purchasing power has resulted in less food and subject to malnutrition. This is because eating patterns become inadequate to provide balanced nutrition, if this condition lasts long enough it will cause food insecurity. The studies were conducted to find out that Jalawure can be promoted as a diversification of food consumption based on the potential of food resources, local wisdom, and specific regional food diversity.

Jalawure (*Taccaceae leontopetaloides*) which is used by some people in the South Coast of West Java can be made as an alternative for food diversification, supporting food security stability so that it can be considered as one of the pillars of strengthening food security. This is very related to the composition of nutrients contained in Jalawure plants, especially carbohydrates which are quite high at 80.11% -88.07% [1-3]. Because Jalawure (*T. leontopetaloides*) is very suitable to overcome food insecurity and famine seasons as an alternative to rice and wheat flour.

2. Materials and Methods

2.1. Research Location

Data collection was conducted in Kertajaya Village, Simpenan sub-district, Sukabumi Regency (7° 4’52.28 "S, 106° 31’4.37" E); Cidamar village, Cidaun sub-district, Cianjur Regency (7° 29’58 "S, 107° 23’3" E); Cicadas village and Cijambe village, Cikelet sub-district (7° 39 ‘40’ 'S and 107° 41’ 11 ” E); Mancagahar Village, Pameungpeuk sub-district (7° 40’6 "S, 107° 41’34” E), and LeuweungSancang Nature Reserve, South Garut, Garut Regency during 2016 - 2018.

2.2. Methods

Data collection was based on primary data and secondary data. Primary data was obtained by direct observation in the field, in-depth interviews to selected resource persons, female farmer groups (KWT), farmer group, communities that use Jalawure as their daily food. Dissemination to family welfare women for its potential use. Holding meetings with residents on how to develop tacca plants, harvesting tubers, post-harvest processing, and drying processing to produce quality and hygiene tacca starch flour. Then to carry out a discussion meeting with Food Security Office, Garut, Office of Statistics, Garut and Office of Forestry and Agriculture Guidance, Garut.

3. Results and Discussion

3.1. General description of the research location

Sangrawayan village (7°04’50.8 "S, 106° 32’46.5" E), Simpenan sub-district, Sukabumi Regency; Cidamar village (7° 29’13.1 "S 107° 21’18.4" E) Cidaun sub-district, Cianjur Regency; Cicadas village and Cijambe village (7° 39 ‘40’ 'S and 107° 41’ 11 ” E), Cikelet Sub-district, Mancagahar village (7° 40’6 "S, 107° 41’34” E), Pameungpeuk sub-district and Leuweung Sancang (7° 41’48 "S, 107° 52’18” E), Nature Reserve Area, Garut Regency. The villages were coastal villages with their main livelihood being fishermen catching fish at sea, and farming on rainfed land.
The economic conditions of coastal residents are generally poor, because they are included in the underpoor or poor, especially fishermen. While the economy is still controlled by people who have strong capital. Fishermen generally have no capital and depending on other people's vessels by means of a middleman system. While fishermen in the waters, their type of fishing gears include payang, beach trawl, gill net etc. But the hardness of the nature they have to face are still considered capable in supporting development, but the contributing factor is restricted to low level of education.

3.2. Botany of Jalawure (Tacca leontopetaloides)

Tacca leontopetaloides with synonym of Tacca pinnatifida has several regional names, namely gadung tikus (Indonesia), kecondang (Java), taka laut (Sumatra), Jalawure, jalamure (West Java) Tahiti arrowroot (English), included in the family Taccaceae., the height can reach 3 m per year, rounded rhizom tubers up to 20 cm in diameter with a weight of more than 1 kg, the bulbs are renewed every year, the old tubers are brown-gray in color and the young are bright creamy colored. On top of the tuber the stalks grow vary in number 1-3, and one inflorescence with stems can reach 2 meters in length. The leaves are simple, long-stemmed in the middle. The flowers cluster in the terminal which are protected by 2 types of bracts in the form of lanceolate having green or greenish yellow color sometimes violet and bractehaving shape like a violet colored stick. The flowers are yellow, rounded circling fruit, seeds vary greatly in shape [4].

Tuber of Jalawure (T. leontopetaloides) is a food source of carbohydrates that can be used as staple food substituting rice and flour. The high carbohydrate content in its starch of 83.07% - 88, 07% (Wardah. et al. 2011, 2015, 2017) is very helpful for South coastal communities of West Java to face famine, and food insecurity. This is due to uncertain natural conditions, the increase in carbon dioxide produced through human activities which is absorbed by the sea so that the acidity of the sea occurring and an increase in sea temperature which causes a decrease in fish population and the farther the fishing area.
Global warming also causes a degradation in coastal and marine ecosystems that will have an impact on the welfare of fishing communities. Conditions like this make it difficult for fishermen to get their catches and the results are a little incompatible with the capital that has been spent. Whereas the decreasing fertile land due to erosion and the expansion of fish pond areas along the coast narrows the people's access to agricultural land being an obstacle to overcome.

Most areas in the southern coast of West Java include rainfed land with uncertain seasonal conditions, the fishermen and farmers can only surrender. Jalawure (T. leontopetaloides), which grows wild and spreads in the South coast of West Java, its starch is consumed and processed as a substitute for rice or wheat flour. Communities on the southern coast of Garut usually use it as an alternative in the famine period.

But not all coastal communities have knowledge about how to process and use Jalawure so that these plants are considered to be unpotential. Therefore, with the socialization of the people who live in coastal areas at the research sites, the plants to be known and they practice the processing technique. In fact, these plants can be used as food storage for local people on the coast in the form of starch flour.

Research which conducted from 2012 to 2014, then continued in 2016-2018 in the South coast of West Java can provide important information about the potential, prospects, and utilization of Jalawure (T. leontopetaloides) for the lives of coastal communities. This is due to finding of the results of the analysis that has been done on the tubers and flour. It turns out that the results of the nutritional analysis and chemical composition of this plant are quite high sources of carbohydrates i.e., 80.11% -88.07% [1-3].

Jalawure (T. leontopetaloides) which grows wild in the southern coast of Garut, Cianjur, and Pelabuhan Ratu and is not cultivated. Dissemination activities to the community through farmer groups, farming group unity (Gapoktan), female farmer groups (KWT), family welfare (PKK), and the community using this plant to inform the importance of this plant as a food source of carbohydrates that can be used as an alternative to overcome food insecurity and famine period.

To explore the potential of Jalawure (T. leontopetaloides), various analyzes on the contents of the tuber were carried out. The results of the analysis of starch flour tubers were found that Jalawure has nutritional content and composition of 80.11% -88.07% carbohydrates, 6.26% protein, 0.98% fat, 1.85% fiber, and energy 369.165kcal / 100g, Mg 97.43 mg / 100g, Fe 6.185 mg / 100g, Ca 283.2 mg / 100g, K 616.635mg / 100g, P 425.82mg / 100g, amylopectin 53.28%, and amylose 27.93 %, vitamin E. 28.46 mg / 100 g, starch 81.21% / 100 g, and FOS 2.16 mg / 100 g [2, 3].

According to Bosha et al. [5], the carbohydrate content is 76%, 6% protein, 4% fiber, 2% ash, and 1% fat. Another finding from Ubwa et al. [6] that the carbohydrate content is 71%, Protein 2%, fiber 4%, and ash 3%, state that carbohydrates contained 88%, 2% Protein, 0.2% fiber, and 1% ash. In addition state that protein content is 6.52%, fat 0.35%, water 16.96%, ash 1.37%, carbohydrate 74%, starch 66.65 %, amylose 22.77%, and amyllopectin 43.88%.
The results of analysis on the starch content of *Tacca leontopetaloides* was between 66.65% - 81.21% /100g, the amylose content was 22.77% -27.93%, and the amylopectin content was 43.88% - 53.28%. Amylopectin content in high starch can be used to make food products that result in more elasticity, increasing crispness, and is not easily cracked or broken. Amylose content which ranging from 22.77% -27.93% plays an important role in increasing hardness, so starch *Jalawure* (tacca) flour is very suitable for making food products such as pastries. In addition, the food produced is not easily broken, and is very good for making instant noodle products.

The tacca starch content ratio is quite high between 66.65% -81.21% which has the potential to increase the resistant starch (RS) content so that it can increase its functional value. Amylose content of 22.27% -27.93% is included in the intermediate category where the value has the potential to increase RS levels through starch gelatinization and retrogradation processes while amylopectin levels of 43.88% -53.28% have the potential to hydrolyze the branching bonds so that produce more amylose for the formation of resistant starch. Through this potential, various modification techniques were carried out to increase the resistant starch content in tacca tubers.

The resistant starch (RS) content in starch flour has the ability to reduce blood sugar and insulin levels, and prevent colon cancer by producing short chain fatty acid (SCFA) through fermentation in the large intestine [7, 8]. Resistant starch has also been shown to have a prebiotic effect on microflora in the intestine, increase cholesterol metabolism, and reduce the risk of colon cancer. In addition, the presence of FOS content in starch flour is closely related to the health of the large intestine, increasing constipation in elderly individual, reducing diarrhea and helping to control cholesterol [9].

In addition to the high carbohydrate content as a food reserve, *Jalawure* has elements of vitamin C and E which can help to improve the nutritional quality of coastal people to face transition season or famine period. The discovery of metal content in *Jalawure* (*T. leontopetaloides*) plants such as tin, 0.07 mg / 100 g, Aluminum, 0.008 mg / 100 g, mercury, 0.026 mg / 100 g, selenium, 0.80 mg / 100 g, manganese, 0, 52 mg / 100 g, Zinc, 1.599 mg / 100. Chromium 0.063 mg / 100 g. are not exceeding the number of milligrams recommended by the American Chemical Society, which is 0.1 mg / day [5].

Therefore *Jalawure* (*T. leontopetaloides*) is recommended to be consumed by humans, based on the composition of the metal contained not exceeding the recommended capacity of 0.1 mg. The survey results conducted by the Research Center for Biology LIPI from 2011 to 2014 and continued with Competitive research and Superior Research LIPI 2016-2018 [3] on people in the southern coast of Garut who consume tubers from its starch have not affected one community to be exposed to poisons. Because people in Garut, especially in Cigadog Village, have been consuming *Jalawure* since their ancestors until now. Even *Jalawure* tubers which stored in the garden are eaten by many herded goats and *Jalawure* planted in the coast if they are not restricted by fences will be eaten by cattle which are deliberately released.

To produce quality *Jalawure* starch and not worrying about metal content, do this in the following way: The content of saponins, 15.20 mg / 100 g, tannins, 3.44 mg / 100 g, alkaloids, 143 mg / 100 g, flavonoids, 1.29 mg / 100 g. and steroids 0.83 mg / 100 g of *Jalawure* starch flour as anti oxidant. Anti-oxidants play an important role in preventing damage by cell free radicals and preventing chronic diseases such as cancer and diabetes, and stopping the proliferation of cancer cells. The saponin content can help reduce cholesterol levels thereby preventing arteriosclerosis and hypertension [6, 10, 11].

The analysis results contained in *Jalawure* (*T. leontopetaloides*) plantsare socialized to the Local Government of Garut, Food Security Agency, Garut District, Fisheries and Forestry Extension Agency of Garut District, Head of Sub-district in the research location, Farmer Groups (Gapoktan), Woman Farming Group (KWT), and farming communities in the coastal areas. The purpose of the socialization is that the Garut Regency Government provides support to the sub-district government for the development of this plant on coastal land that is not used for agriculture. In addition to being able to be used to overcome food insecurity and improve the quality of community nutrition, *Jalawure* can also be a business opportunity to improve the standard of living of the local community.
The establishment of UKM Dahlia Lestari as a result of the support of the local government of Garut Regency and the local government in South Garut helped local communities improve their economies. Small and Medium enterprises (UKM) is a place to accommodate mothers who have the skills in making various food products that can be marketed through local or national markets. The food products produced mainly use Jalawure starch raw materials, but do not rule out the possibility of other raw materials. The development of raw materials is carried out by male farmer groups in places that do not interfere with their main crops, such as corn and secondary crops.

![Diagram of the process of making flour from Jalawure tubers](image)

**Figure 3.** Flow of processing of Jalawure tuber (*Tacca leontopetaloides*) into starch flour

*Jalawure* (*Tacca leontopetaloides*) in the development process does not require special treatment such as other agricultural crops, giving about 1 kg of manure / hole and planting coincides with the rainy season. The seeds used are old enough with the size of the seeds around 50-100g / individu. Usually the planting is done by using the mounds, the purpose is to make it easier to harvest. Harvesting is done by reaching age between 8-10 months. Harvesting time of Jalawure harvest is the same as harvesting in cassava plantations. But Jalawure is harvested at the peak of the dry season, because the starch produced can be maximally produced.

Food Security Agency (BKP) of Garut is very supportive in terms of developing this plant, because it sees the potential and future prospects is large enough so that it is expected to become an Icon of the South Garut region. The Southern Region of Garut is a tourist area visited by domestic tourists as well as foreign tourists. Therefore, the products processed from starch Jalawure flour can be used as souvenirs for tourists visiting the South Garut beach.

Jalawure is not just an alternative food substitute for wheat flour and rice, but its starch has other potential as a food ingredient and is very good for diabetics. The formation of small and medium enterprises (SME) in the village of Cijambe, South Garut is a proof that the community is very consistent in developing the Jalawure in their village. Therefore the Food Security Agency (BKP) of Garut Regency provides assistance to process Jalawure tubers, because processing tubers in large quantities if done manually requires a longer time.

The mechanical process of scarring, the time needed is faster and the operational funds is less. Previously the community was still traditional, so that the selling price of the Jalawure flour was more expensive than the selling price of wheat flour in the market, therefore with improved technology it
was expected that the selling price of Jalawure starch flour would be equal to or lower than the price of flour.

![Jalawure starch flour processing](image)

**Figure 4.** Processing of Jalawure tuber (*Tacca leontopetaloides*) into starch flour. a-b) cleaning tubers, c) scarring process, d) mechanical technology, e) the results of dissolving tubers, f,g) filtering, h,i) starch flour.

This is expected to be able to help people who are not able and who do not have land can afford to purchase. Therefore, Jalawure is potential to be developed along the South coast of West Java starting from Sukabumi, Cianjur, to Garut Regencies. Because starch flour from the tuber is very potential to be used as food diversification and can improve the standard of living of local communities, especially in the coastal areas. Food diversification will have a great value if it is able to explore, develop and optimize the use of existing local food resources while upholding the right to food as a basic human right and local wisdom.

The development of Jalawure in the southern coastal region of Garut is a place for the spread of these plants, but if these plants are not conserved or developed, over the time will experience scarcity and extinction in South Garut. This is due to the conversion of land that has penetrated the southern coast of Garut, where the Jalawure grows along the coast. Therefore the need for attention from the local government how these plants were developed so as to improve the economy of coastal communities. In addition, Jalawure plants have considerable potential that can be used as a solution in dealing with food insecurity and malnutrition.

### 4. Conclusion

Research on Jalawure (*Tacca leontopetaloides*) was carried out in the South coast of West Java during 2016-2018 in Kertajaya village, Sukabumi Regency, Cidamar village (South Cianjur), Cikelet village, Cijambe, Cigadog, Mancagahar, Pameungpeuk, and Leuweung Sancang (Garut Regency). The people who live in the research locations having main livelihood as fishermen and cultivate rainfed land. In general, the economic conditions of coastal communities are not good, because they are included in under poor or poor categories, especially fishermen. While the economy is still controlled by people who have strong capital. The main contributing factor for the poor people is the low level of education.

The analysis of Jalawure starch was found to contain 80.11% - 88.07% carbohydrates, 6.26% protein, 0.98% fat, 1.85% fiber, and energy 369.165 kcal / 100g, Mg 97.43 , mg / 100g, Fe 6.185 mg / 100g, Ca 283.2 mg / 100g, K 616.635mg / 100g, P. 425, 82mg / 100g, amylopectin 53.28%, amylose 27.93%, vitamin E. 28. 46 mg / 100g, starch 81.21% / 100g and FOS. 2.16mg / 100g.
The starch content of *Tacca leontopetaloides* was 66.65% - 81.21% / 100g, the amylose content was 22.77% - 27.93%, and the amylopectin content was 43.88% - 53.28%. Amylopectin content in high starch can be used to make food products that result in more elasticity, increased crispness, and are not easily cracked or broken. Amylose content ranges from 22.77% - 27.93% plays an important role in increasing hardness, so Jalawure starch flour is very suitable for making food products that are not easily damaged, such as pastries. Besides that it is very good for making instant noodle products.

The tacca starch ratio is quite high between 66.65% - 81.21% which has the potential to increase the resistant starch (RS) / content so that it can increase its functional value. Amylose content of 22.27% - 27.93% is included in the intermediate category where the value has the potential to increase RS levels through starch gelatinization and retrogradation processes while amylopectin levels of 43.88% - 53.28% have the potential to hydrolyze the branching bonds so that produce more amylose for formation. The content of resistant starch (RS) in starch flour has the ability to reduce blood sugar and insulin levels.

The high carbohydrate content in Jalawure plants can be used as an alternative solution for people living in the coastal areas to overcome food insecurity and lack of nutrition. In addition, the flour can be used as a food barn for coastal communities. Elements of vitamins C and E contained can help improve the quality of people's nutrition. The FOS content of 2.16 mg / 100g contained in the starch is very much related to the health of the large intestine, and increases constipation in elderly individual, reduces diarrhea and assists to control cholesterol.

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