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Roles of local food and knowledge of indigenous communities during pandemic COVID-19 at three districts across West Papua Province, Indonesia

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Abstract. *Wahyudi, Djitmau DA, Dwiranti F, Sagrim M, Manuhua D. 2024. Roles of local food and knowledge of indigenous communities during pandemic COVID-19 at three districts across West Papua Province, Indonesia. Asian J Ethnobiol 7: 1-12.* The world suffered from the COVID-19 pandemic without exception to local communities in West Papua Province, causing deaths worldwide. During the pandemic, food supply, availability, and distribution were short. Indigenous communities in West Papua Province, Indonesia are surrounded by natural resources providing foods, vegetables, vitamins, and other nutrients for maintaining the human immune system. This research was designed to determine local food diversity, examine the contribution of local foods in fulfilling daily needs, nutrient sources, medicines, and others during the pandemic, and document local community perception of the pandemic COVID-19 among three study areas in West Papua Province. A questionnaire field survey was employed for data collection: 11 villages at three districts in Manokwari, South Manokwari, and Teluk Bintuni were selected to represent coastal, lowland, and mangrove areas. The results indicated that local food provides all daily food needs, offering various ingredients and supporting the livelihood of the local communities. Among the three districts, there are variations in food diversity, but they are similar. Furthermore, 18 plants were consumed as vegetables; 14 plants as carbohydrate sources; 16 plants for fruits, medicinal, herbs, respectively; 13 plants for flavor; Protein and fat-producing plants and animals were 7 of plants and 6 of animal, respectively. They were prepared by boiling, fresh, roasted, burned in a wood fire, and fried gently with cooking oil. These local foods are also the source of house income, offer informal work, and are a source of medicinal plants. When food supply and distribution are scarce everywhere due to the COVID-19 pandemic, the local communities rely on their local foods to maintain their health and immunity. They believe that the COVID-19 virus is a warning from God to humans who always exploit nature without caring for others.

Keywords: COVID-19, local food and knowledge, West Papua

INTRODUCTION

Previuously, Indonesian New Guinea consisted of two provinces, West Papua and Papua Province, which are very rich in terms of flora and fauna biodiversity (Cámara-Leret et al. 2020), cultures, indigenous knowledge as well as local food diversity, traditional recipes, and ethnic diversity (Ananta et al. 2016). Since 2021, this second largest island in Indonesia after Kalimantan has been administrated with four new provinces, namely South Papua, Papua Pegunungan, and Central Papua from Papua Province, and Southwest Papua from the West Papua province, Indonesia. Today, there are six provinces in total. Customary areas and genetic relationships are among the determined factors in dividing the boundary of these four new provinces. It has natural characteristics for its food, vegetables, fruits, houses, and domestic or wild animal consumption (Pattiselanno et al. 2020).

Indonesian New Guinea has various topographies from coast to mountains, mangrove to alpine vegetation, and consuming fishes to wild meat for protein sources, as well as hot in coastal areas to cold in the mountainous areas. Indigenous communities are the local people born and originally from this island having the customary land, while those without customary land are grouped as the local people. They are both the local inhabitants and hereafter designed as the indigenous communities. These indigenous communities live inside, outside, and next to their customary forest or land, cultivating their local foods with simple tools and traditional farming or subsistence agriculture practices (Wahyudi 2014), and these practices are classified as slash-and-burn agriculture (Murdjoko et al. 2022). Most of their local foods are collected from their surrounding forest, cultivated and opened areas classified as secondary forests, practicing subsistence agriculture, slash-and-burn system, and hunting wild meat to get animal protein (Wahyudi 2017).

Local foods are various foods, meals, and drinks consumed by local communities based on their local potential resources and knowledge (*Undang Undang No 18 Tahun 2012 Tentang Pangan* 2012). Local foods have been practiced traditionally by their ancestors for many

generations. Therefore, the local food of the indigenous communities in the coastal areas could be different from those in the mangrove, swamp, and highland areas. West Papua province is inhabited by a diversity of ethnicities, both indigenous and non-indigenous, where the indigenous communities mainly belong to the Arfak tribes, such as Sough, Meyah, Mpur, Wamesa, Sebyar, Irarutu, and the others (Mulyadi et al. 2015). They live from the coastal to the highland areas and consume various foods at their sites. It is approximately 4,514 small to uninhibited islands in which the indigenous people live and rely on their local for their livelihood (Wahyudi et al. 2023). *Sago* is the main staple food of those living in the coastal areas. Fish is the main source of protein and animal fat (Ondikeleuw et al. 2020), while those who live in the mountain area consume sweet potato and potato as their main staple food (Yamamoto et al. 2020) and bush meat for their animal protein and fats (Iyai 2019).

Local knowledge or local wisdom is knowledge practiced by local communities inherited from their ancestors and results of adaptation to their natural condition, and this uniqueness is originally from nature (Sagrim 2022). This knowledge is applied to various livelihood aspects, ranging from crop plantations, food consumption and cultivations, traditional recipes, and utilization of specific plants for medicinal purposes and others (Toansiba et al. 2021; Nainggolan et al. 2022; Ap et al. 2023).

The COVID-19 pandemic has spread out through the globe and West Papua Province without an exception. This global pandemic contributes to difficulties for public transport operations, delivery, health facilities, care shortages, food shortages, and distribution. In contrast, the food shortage, for example, was not applied here in most areas of West Papua Province, both in the towns and villages. It is because of the availability of the local food diversity being planted or cultivated, and even they could be gathered directly from the surrounding resources of the indigenous communities. The local foods are harvested from farming practices, collected from their surrounding customary lands, primary and secondary forests, and used for daily necessities of food, medicine, vegetables, and income (Wahyudi 2017). The indigenous communities practice traditional farming to fulfill their daily nutrition, feed their family, maintain their health and growth, create informal works, generate house income, and make social and cultural obligations to their ancestors and nature. Therefore, this study is designed to investigate and explore the local food diversity at three West Papua Province districts and determine the variety of local food utilization. The local community's perspective on the COVID-19 pandemic roles of local food during this pandemic is recorded.

MATERIALS AND METHODS

Research sites

This research was conducted at three different districts of West Papua Province, Indonesia: Manokwari, South Manokwari, and Teluk Bintuni. The research site at Manokwari District was in the sub-district of North Manokwari, involving three villages: Nuni, Bremi, and Yoom. South Manokwari District consists of two sub-districts: Ransiki and Momiwaren. Two villages in the Ransiki sub-district are Ransiki and Dembek, while Siwi dan Waren were two villages in the Momiwaren Sub-district. Four villages were selected from the Teluk Bintuni District: Inyesta and Tausida were located in the Tuhiba Sub-district, and Atibo and Tihibo Villages represented the Manimeri Sub-district. Research sites are mapped in Figure 1. Number of villages in total were 11. Data were collected during intensive interviews based on a prepared questionnaire; each village has four respondents, or 36 were interviewed. Field visits were also conducted to identify the indigenous communities that cultivated or growing plants in their garden and the cultivation land.

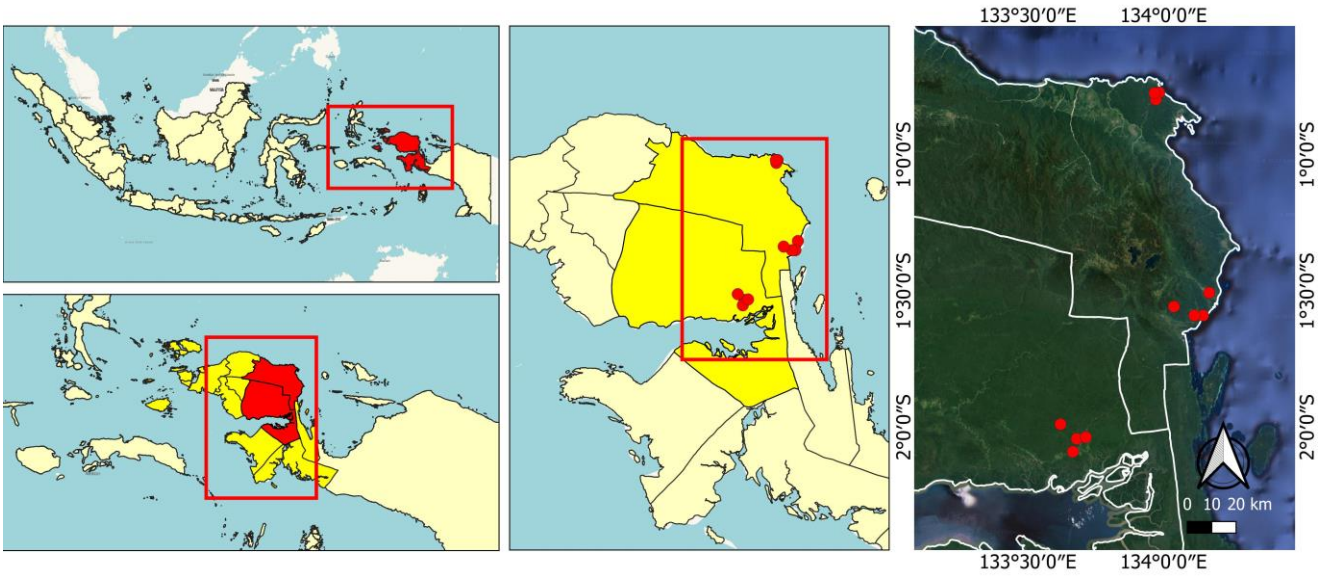

Figure 1. Research sites at three districts of West Papua Province, Indonesia: Manokwari, South Manokwari, and Teluk Bintuni

Description of the research sites

The 11 villages at three different districts and five sub-districts were selected as the research sites. Teluk Bintuni District has natural characteristics close to the mangrove ecosystem, with swamp vegetation partly with dried agricultural practices. Therefore, using a double cabin car, this place can be reached from the capital city of the West Papua province, Manokwari, approximately 6-7 hours with average weather and dried road. South Manokwari District is dominated by lowland vegetation without water access and can be reached from Manokwari city for four hours driving the double cabin car. Manokwari Utara sub-district can be reached from Manokwari city for 1-2 hours with the double cabin car, and this research site is located next to the north coastal areas of Manokwari District. The three research sites depend on the rainfall for watering their agricultural practices.

Procedure

Field survey

The field survey was conducted twice; the first was an initial survey to examine the availability of targeted respondents and local food commodities. This selection of the targeted villages was conducted due to pandemic COVID-19 restrictions and health protocols and procedures. An initial survey was finished, and 11 villages from 3 districts were selected as research sites, as illustrated in Figure 1. The second survey collected the data and pictures and interviewed the selected respondents. During these surveys, personal health protection and general regulations provided by the COVID-19 local task force, including an official letter of COVID-19 declaration, were applied to the researcher teams, the selected respondents, and community members.

Selected respondents

Stratification methods were used to select the respondents according to the social culture rules of the local communities. Traditional leaders, heads of the villages, the young generation (both men and women), and several highly active women involved directly in local food farming, selling and harvesting, and other involvements are selected for respondents. In total, 30 respondents were interviewed: 11 traditional leaders/heads of villages, one cultural leader, and 18 women of various ages. Most of the respondents for the active farming practices, selling and harvesting their local foods, are women.

Data collection

Data collection was conducted with an interview using the prepared questionnaires. Interviews to collect the data were conducted at many places, i.e., houses, yards, balconies, fields, and agriculture fields. Field visits and surveys were also conducted to collect the picture for supporting data and gather more information regarding the actual condition of the agricultural commodities planted and the condition of the field.

Data analysis

Data collected from interviews and field visits were tabulated and presented in tables and charts. Pictures were also used to display or illustrate the field findings of the local community agricultural practices.

RESULTS AND DISCUSSION

Widely acknowledged, food has been covered with various definitions because food is all consumable material originally gathered from nature and processed in the form of solid, liquid, and in between, with the main goal of providing human needs for growing, developing, and maintaining human health. These local foods recorded and reported here are mostly fresh and edible foods harvested from the farming sites of the local communities. Utilizations of the local foods for various food-based main ingredient sources are grouped for vegetables, carbohydrates, fruits, medicinal purposes, protein and fat producing plant and animal, and cooking energy.

The results indicated that local foods ranging from tubers, vegetables, and fruits to wild animal flesh play significant roles in fulfilling the daily ingredients of the local communities during COVID-19 pandemic. These local foods grow naturally, are partly cultivated, and are managed with their farming or slash-burn rotation systems. These daily activities, such as traditional farming, collecting local foods, and other related activities, contribute to keeping the local communities' human body in a steady state of healthiness, maintaining the spirit of optimism, which will automatically create autoimmune system in response to the COVID-19 virus. The local communities believe nature has a natural response mechanism to finish this pandemic.

The following paragraphs elaborate on the diversities of the local foods functioning for vegetables, carbohydrate sources, protein and fat-producing plants and animals, and others. The last paragraph of this section elaborates on the roles of local foods during the COVID-19 pandemic concerning the indigenous communities' perceptions, attitudes, and actions.

Vegetables

The list of plants, their botanical and local names, and parts of plants utilized for vegetables by the local communities at three districts in West Papua Province are tabulated in Table 1.

Table 1 indicates that the indigenous communities at three research sites, Manokwari, South Manokwari, and Teluk Bintuni, had similarities in harvesting and consuming the local foods for vegetable purposes. Therefore, 19 plants are consumed for vegetables, cultivated and harvested from their surrounding environment. The Gnemo, in national terms acknowledged as *melinjo*, *katok*, and *nangka*, were absent at South Manokwari and Teluk Bintuni, respectively. It is probably due to the condition of the traditional farming fields, where both locations are arid, without a population of this plant recorded on the field. Still, this plant is consumed and traded by the local community. The leaf is a major part of the plants (87%) used as vegetables, followed by fruits, flowers, and young stems. These local vegetables are consumed mainly by boiling in hot water and mixed with other vegetables during cooking.

Table 1. List of plants, their botanical and local names, and parts of plants utilized for indigenous communities as vegetables at three districts in West Papua Province, Indonesia

Local Name	Indonesian and Botanical Names	Parts of the Plant Used	Method of Consumption	Research Sites		
				M	MS	TB
Kasbi merah lancip	*Ketela pohon/ubi kayu* (*Manihot esculenta*)	Leaf, young leaf/shoot	Washing, boiled, mixed with others and added with local spice, or fried with gentle oil, mixed with other vegetables, and consumed with carbohydrates	√	√	√
Kasbi merah lancate	*Ketela Pohon/ubi kayu* (*Manihot esculenta*)	Leaf, young leaf/shoot		√	√	√
Kasbi daun putih	*Ketela Pohon/Ubi kayu* (*Manihot esculenta*)	Leaf, young leaf/shoot		√	√	√
Gnemo	*Melinjo* (*Gnetum gnemon*)	Leaves, young fruit, seed bark, nut	Leaf, young fruit, and whole seed barks are boiled in water and mixed with another vegetable; nuts are sold	√	-	-
Gedi daun lancip	*Gedi lancip* (*Abelmoschus manihot*)	Leaf	Boiled and fried with gentle oil and mixed with other vegetables	√	√	√
Gedi daun lebar	*Gedi putih* (*Abelmoschus rhodopetalus*)	Leaf		√	√	√
Gedi daun merah	*Gedi merah* (*Abelmoschus filculneus*)	Leaf		√	√	√
Katok	*Katuk* (*Sauropus androgynus*)	Young leaf	Boiled and mixed with other vegetables	√	-	-
Jantung Pisang	*Jantung pisang* *(Musa* spp).	Male flower/ Bracts	Fried with gentle oil and boiled with other vegetables in mixing	√	√	√
Nangka	*Nangka* (*Artocarpus hetrophyllus)*	Young fruits	Pull the outer fruit skin; the inner part was chopped and boiled with water and other vegetables	√	-	-
Batatas merah	*Ubi jalar merah* (*Ipomoea batatas*)	Young leafs and stem	Washing, boiled, mixed with others and added with local spice, or fried with gentle oil and mixed with other vegetables	√	√	√
Betatas putih	*Ubi jalar putih* (*Ipomoea batatas*)	Young leaf and stems		√	√	√
Pepaya	*Pepaya* *(Carica papaya)*	Leaf	Boiled, mixed with others, and added with local spice, or fried with gentle cooking oil	√	√	√
Pepaya	*Bunga pepaya* (*Carica papaya)*	Flower		√	√	√
Ketimun	*Mentimun* (*Cucumis sativus*)	Fruit	Eat directly for salad	√	√	√
Sawi	*Sawi hijau* *(Brassica chinensis)* var. *parachinensi*	Whole leaf	Boiled and fried gently with cooking oil	√	√	√
Labu	*Labu* (*Cucurbita moschata)*	Leaf, and fruit	Leaves are boiled and fried with cooking oil and others; the fruits are steamed, boiled, and sold rapidly.	√	√	√
Bambu	*Tunas Bambu*/Rebung (*Dendrocalamus* spp., *Gigantochloa* spp.)	*Rebung bambu*	Boiled mixed with other, sold in solid or sliced shape	√	√	√
Bayam	*Bayam* (*Amaranthus dubius, A. tricolor, A. cruentus*)	Leaf	Boiled and fried with gentle oil	√	√	√

Note: M: Manokwari, SM: South Manokwari, TB: Teluk Bintuni

Carbohydrate sources

Carbohydrate is an essential nutrient mainly used for producing energy for daily activities. Naturally, carbohydrates are produced from various cultivated and non-cultivated plants. Terms non-cultivated means that these plant-producing carbohydrates are not planted on a massive scale, using systematic irrigation, intensive labor, and care. However, these plants are planted in a very natural way and harvested with the main purpose of fulfilling the daily needs of the main staple food or carbohydrate of the local and indigenous communities.

Plant-producing carbohydrates planted and used by the local communities at three West Papua Province districts are summarized in Table 2. This table shows that the indigenous communities at three districts have various plant-producing carbohydrates, 14 plants in total, and the two plants were confirmed not being consumed. These plants were not on the list recorded on their agricultural land practices but are growing outside as wild plants. Most of the plants used for carbohydrates are the tuber, followed by the mature fruit. These staple foods are consumed in various methods such as boiling, fried with cooking oil, fresh state, and burned in a wood fire. *Pisang kapuk* and *tanduk*, the two bananas, are consumed by exposure or fire in wood, either in the field or in homes.

Table 2. Local, Indonesian, and botanical names of the plant-producing carbohydrates planted and used by the local communities at three districts in West Papua Province

Local Name	Indonesian and Botanical Names	Part of the Plant Used	Method of Extraction or Consumption	Research Sites		
				M	MS	TB
Kasbi daun merah lancip	*Ketela pohon* (*Manihot esculenta*)	Tuber	Boiled and fried with cooking oil	√	√	√
Kasbi daun merah lancete	*Ketela pohon* (*Manihot esculenta*)	Tuber		√	√	√
Kasbi daun putih lancip	*Ketela pohon* (*Manihot esculenta*)	Tuber		√	√	√
Batatas putih	*Ubi Jalar* (*Ipomoea batatas*)	Tuber		√	√	√
Batatas merah	*Ubi Jalar* (*Ipomoea batatas*)	Tuber		√	√	√
Pisang raja	*Pisang raja* (*Musa paradisiaca*)	Mature fruit	Boiled, fresh consumption	√	√	√
Pisang kapuk	*Pisang kepok* (*Musa acuminata* subsp. *acuminata*)	Mature fruit	Boiled, fried with cooking oil, burned on the wood fire	√	√	√
Pisang Tanduk	*Pisang tanduk* (*Musa acuminata* var. *typica)*	Mature fruit	Boiled, burn in the wood fire	√	√	√
Keladi	*Bete/Keladi* (*Caladium esculenta*)	Tuber		√	√	√
Talas	*Talas* (*Colocasia esculenta*)	Tuber		√	√	√
Ganyong	*Ganyong* (*Canna discolor*)	Tuber	-			
Sagu	*Sagu* (*Metroxylon sagu*)	Starch	Dilluted into hot water or	√	√	√
Sukun	*Sukun* (*Artocarpus altilis*)	Mature fruit	Boiled and fried with cooking oil	√	√	√
Uwi/Gembili	*Uwi/Gembili* (*Dioscorea esculenta*)	Tuber	-			√

Note: M: Manokwari, SM: South Manokwari, TB: Teluk Bintuni

Table 3. Local, Indonesian dan botanical names, and part of various plants producing fruit cultivated and harvested by three different local communities in West Papua

Local Name	Indonesian and Botanical Name	Method of Consumption	Research Sites		
			M	MS	TB
Rambutan	*Rambutan* (*Nephelium lappaceum*)	The flesh of fruits is consumed directly	√	√	√
Durian	*Durian* (*Durio zibethinus*)	The flesh of the fruit is consumed directly	√	√	√
Nangka	*Nangka* (*Artocarpus heterophyllus*)	The flesh of the mature fruit is directly consumed	√	√	√
Langsat	*Langsat* (*Lansium domesticum*)	The flesh of fruit consumed directly	√	√	√
Pepaya	*Papaya* (*Carica papaya*)	The flesh of the mature fruit consumed directly	√	√	√
Pisang Ambon	*Pisang ambon* (*Musa paradisiaca*)		√	√	√
Pisang Nona	*Pisang nona* (*Musa banksii*)		√	√	√
Pisang Raja	*Pisang raja* (*Musa acuminata*)		√	√	√
Alpukat	*Alpukat* (*Persea americana*)		√	√	√
Nanas	*Nanas* (*Ananas comocus*)		√	√	√
Geawas	*Jambu biji* (*Psidium guajava*)		√	√	√
Mangga	*Mangga* (*Mangifera indica*)	The flesh of the mature fruit consumed directly	√	√	√
Jambu monyet	*Jambu* air (*Syzygium aqueum*)		√	-	√
Sirsak	*Sirsak* (*Annona muricata*)		√	√	√
Buah Nona	*Srikaya* (*Annona squamosa*)		√	√	√
Matoa	*Matoa* (*Pometia pinnata*)		√	-	√

Note: M: Manokwari, SM: South Manokwari, TB: Teluk Bintuni

Table 4. Plants consumed and used with the purpose of medicinal goals, with their local, Indonesian, and botanical names, recorded from three local communities in West Papua Province, Indonesia

Local Name	Indonesian and Botanical Names	Parts of Plants Used	Application Method	Medicinal Purposes	Research Sites		
					M	MS	TB
Cocor Bebek	*Cocor Bebek* (*Kalanchoe pinnata)*	Leaf	Leaves are washed, crushed, and smeared on the targeted body areas from the fresh wounded, cut, and scratches	Fresh wounds, cuts, and scratches	√	√	√
Batatas merah	*Ubi Jalar* (*Ipomoea batatas*)	Leaf	Young leaves are washed, boiled, fried with gentle oils, and consumed	Diare, menstruation, pain reduction	√	√	√
Jahe	*Jahe* (*Zingiber officinale*)	Rhizome	Washed, sliced, and crushed mixed with other vegetables, drinks, chopped as salad fresh	Cough, body warm-up, cold	√	√	√
Kunyit	*Kunyit* (*Curcuma longa*)	Rhizome	Rhizomes are washed, peeled out of the skin, grated, and extracted with water by squeezing. The extracted water is filtered, poured into the destinated cooking foods, or drunk directly with an addition of honey or lemon	Various local foods ingredients, human immunology, inflammation, menstruation pain killer, bloated stomach, and wound compress	√	√	√
Lengkuas	*Lengkuas* (*Alpinia galanga*)	Rhizome	Washed, sliced, and mixed with the food during cooking	Food flavor, in general	√	√	√
Pare	*Pare* (*Momordica charantia*)	Fruits and young leaf	Chopped the mature fruits, boiled and fried with gentle cooking oil; young leaves are crushed, extracted with cold water, and consumed with honey added	Antimarial purposes were due to its bitterness and phlegm secretion for babies.	√	√	√
Ceplukan	*Ceplukan* (*Physalis angulata*)	Fruits	Consumed mature fruits directly	Inflammation and self-immunology	√	√	√
Jeruk Suanggi	*Sukade* (*Citrus medica*)	Fruit	Sliced and squeezed to collect the water and applied to any fresh food to be cooked; squeeze the skin to get the essential oil for the skin	Source of Citric acid and essential oil for skin protection collected	√	√	√
Jeruk Nipis	*Jeruk nipis* (*Citrus aurantiifolia*)	Fruits	Sliced and squeezed to collect citric acid for beverage flavors, extracted water mixed with warm water and honey, and consumed directly	Beverage and salad flavor, flue and cough, and self-immune system	√	√	√
Jeruk Purut	*Jeruk purut* (*Citrus hystrix*)	Fruit and leaf daun	Mature fruits and young leaves are crushed and mixed with various foods and salads	Various food and salad flavors	√	√	√
Kemangi	*Kemangi* (*Ocimum basilicum*)	leaf and seed	Leaf consumed fresh or mixed directly into a salad or cooking food; seeds are dipped into cold water to swell and mixed with the fruits-beverage	Natural flavor, self-healing, and inflammation	√	√	√
Cabe	*Cabe* (*Capsicum frutescens*)	Fruits	Fresh mature fruits are consumed directly after being mixed with other ingredients	Warming the human body when getting malaria symptoms,	√	√	√
Sereh	*Serai dapur* (*Cymbopogon citratus*)	Stem	Fresh stems boiled with other food during cooking, chopped fresh stems poured with hot water and filtered cold water consumed directly, or added with sugar	Food flavors, immune system, cough and cold recovery, and warm beverage	√	√	√
Giawas	*Jambu biji* (*Psidium guajava*)	Fruit and young leaf	Fruits consumed in fresh and young leaves are chewed and crushed with water to get water extracted and consumed	Source of vitamin C for cold, leaf or its extract for diarrhea recovery	√	√	√

Note: M: Manokwari, SM: South Manokwari, TB: Teluk Bintuni

Fruits

Manokwari, the capital city of West Papua province, is acknowledged as the city of fruits, where the durian, rambutan, and alpukat have unique flavors and textures. These tropical fruits naturally offer various essential ingredients important to humans, such as vitamins, minerals, and fibers. Fruits are enriched with various bioactive compounds serving as natural antioxidants, anti-inflammation, diabetes, and others. The diversity of the fruits, their local, Indonesian dan botanical names, and various plant parts producing fruit cultivated and harvested by the local people in three districts of West Papua Province are tabulated in Table 3.

The variety of the local fruit recorded at three districts was 16, but *Matoa* and *Jambu air* are absent in South Manokwari. This is probably because the selected respondents have no farming lands or these areas without *matoa* and *jambu air* growing. Most local fruits are annual plants with periods or seasons for producing fruits. However, various non-seasoning fruits are capable of producing fruits many times a year, like non-woody plant-producing fruits such as *nanas*, *sirsak*, *buah nona*, papaya, and banana have no seasonal producing fruits, meaning that these plant-producing fruits will produce fruit year-round.

Medicinal plants

The plant has fulfilled all human needs, serving nutrition ingredients, maintaining human health, producing human autoimmune systems, and promoting growth and development. Naturally, these autoimmune systems are acting due to the foods we consume. The consumed plants are widely acknowledged as functional foods, meaning all foods we consume have specific functions for our human body, and foods have various functions as natural drugs.

Plants consumed and used with medicinal goals, with their local, Indonesian, and botanical names, recorded from three districts in West Papua Province are shorted in Table 4.

Table 4 illustrates 13 plants recorded from three districts of West Papua Province utilized for traditional medicine, preventing and curating any health problems, diseases, and health syndromes. These plants are grouped as functional foods consumed in single or combined with the others, and their functionalities are designed for specific purposes or consumed as cooking flavors or aromatic agent producers. *Giawas* and *cocor bebek* are the functional plants used in a fresh state for diarrhea recovery and inflammation, respectively.

Protein and fat-producing plants and animal

Plants and animals produce protein and fat most naturally, classified into vegetable and animal fats. The diversity of the plants and animals producing protein and fat recorded from three districts in West Papua province is shown in Table 5. This table highlights the diversity of the local foods used by the local communities at three districts of West Papua Province for sources of protein and fat from plants and animals. Furthermore, seven plant-producing protein and fats were recorded from three districts, and six animal-producing protein and fat from districts, except for Mangrove crabs, which is only recorded in Teluk Bintuni (TB) District. This is highly related to the natural habitat of mangroves in this area, which are absent both in South Manokwari and Manokwari Utara, mainly on the research sites. Interestingly, the majority of protein and fat collected from the animal is from hunting animals or wild animals, except for domestic chicken (*ayam kampung*).

Cooking energy

Generally, the energy consumption for indigenous communities in West Papua province could be differentiated into energy for electricity and domestic consumption, mainly for kitchen energy or cooking, warming houses, and others. Herewith, energy consumption is more focused on cooking energy or firewood. Home energy for lighting, electronic devices, and others is supplied by the governmental authority for national electricity, even though the official services are short of 6-12 hours, mainly during the night period, and occasionally operate for the whole day and night at the capital city of the district.

Firewood is the indigenous communities' most cooking energy source at three districts. The abundance of woody plants resulting from the shifting cultivations, opening farming land practices, and hunting to the surrounding forest have influenced to support their potential utilization and availability. Firewood is used for cooking energy in the farming field and homes. It is widely acknowledged that kerosene is the most favorable energy for cooking purposes in the Eastern Indonesian archipelago. However, the availability of this non-renewable energy is limited, shortage, and out of stock, and we must be in line to get 5-10 liters, which is time-consuming for most people. This energy is a government subsidiary program for the poorest. Utilizing firewood also produced added values for charcoal, which could be used for another energy and natural soil absorbent and ash for natural fertilizer for the local plants producing foods.

Perceptions, attitudes, and actions of COVID-19

COVID-19 is a global pandemic, and the impacts were systematic to all aspects of human civilizations. Nowadays, these multiple impacts are still being perceived globally in the economic sectors, food and energy productions, distributions, and others. The indigenous communities in West Papua Province experienced this pandemic difficulty living generally in the traditional way, and they were not overwhelmed to react and adapt to these extraordinary conditions. It is in contrast to those living in the modern society or city, where worry, fear, anxiety and other mental health issues dominate their daily life. The indigenous communities' perceptions, attitudes, and actions in responding and adapting to this pandemic COVID-19 are documented to be shared with the others.

Various responses are recorded from the indigenous communities of three districts across West Papua Province, related to their perceptions, attitudes, and actions personally and communally due to COVID-19. These responses are summarized in Table 6.

Table 5. Diversity of the plant and animal producing protein and fat, with their local, Indonesian, and botanical names recorded from three districts in West Papua Province, Indonesia

Local Name	Indonesian and Botanical Names	Parts of the Plant Used	Consumption Method or Preparation	Research Sites		
				M	MS	TB
Plant Group						
Kacang tanah	*Kacang tanah* (*Arachis hypogaea*)	Seed/Peanut	Peanuts consumed while fresh or boiled in hot water	√	√	√
Kacang panjang	*Kacang panjang* (*Vigna cylindrica*)	Seed pod and young pods	Mature or young pods consumed fresh or boiled with another vegetable, fried gently with cooking oil and other vegetables	√	√	√
Buncis	*Kacang buncis* (*Phaseolus vulgaris*)	Pods	Boiled and or fried gently with cooking oil combined with other vegetables		√	√
Buah Merah	*Buah merah* (*Pandanus conoideus*)	Fruits	Seed peeled out from the cobs, boiled with hot water using a pan to collect oil and filtrate	√	√	√
Jagung	*Jagung* (*Zea mays*)	Corncob	Corn boiled, roasted, and cut into small size mixed with other vegetables	√	√	√
Kacang ijo	*Kacang Ijo* (*Vigna radiata*)	Mung beans	Bean boiled and mixed with coconut milk and sugar			√
Kelapa	*Kelapa* (*Cocos nucifera*)	Coconut	Young and mature coconuts are consumed freshly or extracted to collect coconut milk and poured into any cooking food	√	√	√
Animal group						
Kuskus	*Kuskus* (*Spilocuscus papuensis*); (*Phalanger gymnotis*)	Flesh	Flesh extracted from the skin and bone, roasted and boiled to be consumed	√	√	√
Tikus tanah	*Bandikut* (*Isoodon macrourus*)	Flesh	Whole body roasted or boiled and consumed for their meat	√	√	√
Rusa	*Rusa* (*Cervus timorensis*)	Flesh	Extract the flesh, boiled or roasted, for eating meat	√	√	√
Babi	*Babi* (*Sus scrofa* subsp. *domesticus*)	Flesh	Extract the flesh, boiled, or roasted to be consumed	√	√	√
Ayam	*Ayam kampung* (*Gallus gallus* f. *domesticus*)	Flesh	Flash consumed by boiling and roasted	√	√	√
Caraca	Mangrove crap (*Scylla serrata*)	Flesh	Flash consumed by boiling in hot water	-	-	√

Note: M: Manokwari, SM: South Manokwari, TB: Teluk Bintuni

Table 6. Various responses were recorded from the indigenous communities at three districts across West Papua Province, Indonesia

Responds	COVID-19 Attributes			Research Sites		
	Perception	Attitudes	Action	M	MS	TB
Causing death	√	-	-	√	√	√
Believe in this pandemic from God	√	-	-	√	√	√
It could be managed and finished naturally	√	-	-	√	√	√
Positive thinking	-	√	√	√	√	√
Calm and not panic	-	√	√	√	√	√
Live normally	-	√	√	√	√	√
Friendly with nature	-	√	√	√	√	√
Consume local food and its ingredients.	-	√	√	√	√	√
COVID-19 safety regulation (health protocol)	-	√	√	√	√	√
Personal health resilience	-	√	√	√	√	√
Local community own resilience	-	√	√	√	√	√
Personal soul/non-physical resilience	-	√	√	√	√	√
Physical resilience	-	√	√	√	√	√
Resilience of inflation or rising prices of the daily basic needs	-	√	√	√	√	√
The resilience of attitude and behavior for collaboration, togetherness, and unitedness	-	√	√	√	√	√
Natural occurrence	√	-	-	√	√	√

Note: M: Manokwari, SM: South Manokwari, TB: Teluk Bintuni

Table 6 illustrates various responses classified for perception, attitudes, and actions recorded from the research sites related to COVID-19. The majority of the respondents positively responded through their perceptions. They acknowledged that the pandemic COVID-19 could cause death to all humans. However, the indigenous community had the deepest relation to their natural surrounding environment, including God, and believed in the natural power of recovery. Their perception also highlights that this pandemic will be recovered naturally.

Related to the attitudes, the indigenous communities majority had positive thinking about this pandemic, living normally and friendly with the surrounding nature, consuming their local foods on the research sites, keeping physical activities in farming land, and were resilient for the personal and communal member. At the same time, collaboration and obeying the local government and COVID-19 safety regulations were essential in preventing and isolating the spread and ending this pandemic. Table 6 also summarizes that the attitudes and actions of the indigenous communities in responding to the COVID-19 pandemic are similar and applied to the three districts across West Papua Province.

Discussion

Local foods and knowledge exist in the indigenous communities at three districts across the West Papua Province: Manokwari, South Manokwari, and Teluk Bintuni. They have contributed to overcoming the difficulty, offensiveness, and boundary restriction period of COVID-19. The local foods combined with the local wisdom of the indigenous community can provide and fulfill the livelihood needs of the local communities for a range of necessities (Zhang et al. 2019), such as carbohydrates, vegetables, vitamins, protein, and fat, as well as the auto human immune system required for personal and communal resilience to COVID-19. Diversity and availability of local food for any consumption needs and times of consumption are the two advantages compared to processed foods supplied from factories or any others or instant or fabricated foods (Afriansyah and Dewiyanti 2020). The local foods also provide multiple benefits to the indigenous communities, from fulfilling their health ingredients and nutrition (Hujairin et al. 2017) to offering extra work to gather an extra household income (Toansiba et al. 2021). Physical exercise, exposure to direct sunlight, and fresh open air are all required to defend the COVID-19 recovery.

Figure 2. Group of sweet potato stems planted by the indigenous community, A. Cuttings of sweet potato stem, B. Growth of the sweet potato cutting

Figure 3. Local recipe for *Garnisun* consisting of leaves of A. Sweet potato and papaya and B. Young leaf of pumpkin or tendril

The local wisdom in cultivating, harvesting, preparing, and consuming the local foods in fresh or processed stages has enriched the diversity and availability and multiplied the essential ingredients and nutritious elements for the local community's health and fitness. In standard methods, a single sweet potato stem is planted on a single hole for optimum growth, development, and production of tubers. However, the indigenous communities have different perspectives, and they are planting sweet potato stems an average of 4 to 5 stems together in a single hole and planting in the dominant sandy soil (illustrated in Figure 2.A-B). Planting more than a single stem on a single hole is probably due to the main concern of the watering system or water unavailability, which relies entirely on rainfall for plant watering. It also sounds logical, makes sense and reasonable that when a single stem is dead, the remaining two or more stems remain to grow, and this probability has been a practice for many generations.

The diversity of the local foods the indigenous communities consume for vegetable purposes at three districts in West Papua Province indicates that the leaves are the dominant part of the plant harvested. These leaves are collected mainly from the plants growing in their surrounding environment and agricultural land practices. Concerning their natural characteristics, these vegetables are rich in nutrients and ingredients required by the human body and health, such as vitamins, minerals, and fiber (Berti and Mulligan 2016). They are the majority annual crops, and 24% of these vegetables belong to seasonal crops such as *labu*, *bayam*, *sawi*, and *ketimun*. These annual crops require less plant care and water demand, and intensive labor or work is optional. This condition is naturally parallel with the availability of agricultural tools, natural characteristics of the research sites, and climate.

The indigenous community also has unique recipes for preparing their vegetable ingredients according to their needs and the availability of the local plants. *Garnisun* is a local-famous name for two vegetables consisting of papaya and sweet potato leaves, as shown in Figure 3.A. The other vegetable in locally high demand is the young leaf of pumpkin or tendril, as illustrated in Figure 3.B.

Garnisun refers to the collectiveness effort or military patrol to combat and maintain conducive situations or security and is applied to the military terminology. In the beginning, it was probably various difficulties with these vegetable recipes. Finally, *Garnisun* was selected to represent the philosophy of combatting any failure condition and maintaining our body for health and fitness. These vegetables are prepared by chopping them into small-thin sizes, washed, and fried in gentle cooking or essential oil with the addition of natural seasoning and flavors depending on the recipe. The general taste and texture are combined bitterness, oiled soft whiteness texture, strong flavors of papaya aromatic, and slippery when swollen. This recipe could be consumed with various traditional sources of carbohydrates or rice and chilled fish.

Figure 4. A. A packet of local foods consisting of boiled taro, sweet potato, vegetables, fish, and pork at the local market close to public transport and B. The flesh of the hunted animals of deer and kangaroos

Figure 5. A. Unripped round firewood material and B. Dried sticks of firewood from mangroves used by the indigenous community at the research sites

The indigenous community at the three districts across West Papua Province had carbohydrates from various sources and plant parts (Bintoro 2020), their sources from tubers, fruits, and starch of their surrounding plants. These whole plants are classified into annual crops, meaning growing and producing carbohydrates yearly (no seasonality). The indigenous community does not consume the two plants known as *ganyong* and *uwi*, they produce carbohydrate plants that grow naturally in their surrounding environment. It is probably due to several reasons, and it could be unrecognized, complicity in preparation, and others. These two local foods could be domesticated and promoted for future food security, mainly potency the local food for food security.

Local foods for the indigenous community act as functional food for their health and fitness. The surrounding environment provides various and never-ending sources of plants potentially utilized for food and beverages. The local foods, in general, are biological ornaments being part of nature willing to support their ecosystem component substances. This situation is also applied to the diversity of fruits and biological matters producing protein and fat consumed by the indigenous community. These potential resources for producing fruits, protein, and fat contribute significantly to the indigenous community's daily livelihood, covering all aspects of health, economy, and society (Cvijanović et al. 2020). A packet of local food recipes and ingredients famous for the local community during traveling is shown in Figure 4. This local food has perfect ingredients and nutrition of carbohydrates, vitamins, minerals, protein, and fat (Sembori and Tanjung 2018). A single traditional food packet is designed to serve a single person, but this could serve more than one person, as illustrated in Figure 4.A. This traditional food packet includes fried and seasoned fish, sweet potato, taro, vegetables, and chili sauce. The protein and fat are frequently replaced with other animal meat, like pork or other meat from hunting wild animals such as deer and kangaroos. The animal flesh collected from the hunted wild animals, deer and kangaroos, is shown in Figure 4.B.

Firewood is still the best option and renewable energy available for the domestic energy needs of the indigenous communities across West Papua Province (Wahyudi et al. 2021). This green energy is easily applied, available at any time required, no additional fabricated material is needed, and less accidental occurrences and everyone can use it. Firewood is biomass or lignocellulosic energy-based, and its abundance in nature is enormous. The indigenous community collects firewood from their surrounding forest or environment without charge. These firewood sources include dead trees, dried branches, residual woody material from land clearing, shifting cultivation, and unproductive trees. A picture of round firewood material available in the research area is presented in Figure 5.A-B.

Concerning the COVID-19 pandemic, most respondents responded that the perceptions, attitudes, and actions collected from the indigenous community at three districts across West Papua Province are similar (Table 6). The main perception of the COVID-19 pandemic is that it can cause death to everyone without exception, but they strongly believe that this pandemic is from God and could be managed and will be finished naturally. This perception indicated that the indigenous communities had complete confidence in adapting to the COVID-19 Pandemic. This confidence of the indigenous communities is actualized in attitudes and actions. Moreover, 12 attitudes and actions are recorded with diverse and deep meanings. These attitudes and actions are an actualization of the local knowledge or wisdom of how the indigenous communities interact and are friendly to their nature, taking care and consuming their local foods (Sagrim et al. 2020) and maintaining their physical and mental health by doing daily and farming activities, follow the COVID-19 safety protocol and obey government pandemic regulations. Besides those facts, the diversity, availability, freshness, and richness of ingredients and nutrition from the local foods consumed always supply the local communities' livelihood needs, energy, and healthiness in natural and sustainable ways (Brunori et al. 2016).

In summary, it is highlighted that the local foods offer major food ingredients and nutrition for the local communities during the COVID-19 pandemic by maintaining their healthiness and fitness. Local food ingredients, complete nutrition facts, and recipes provide extra fulfillment to the local communities' resilience by achieving food security from their local foods. The resiliencies of the local communities are manifested in various perceptions, attitudes, and actions adapted to the COVID-19 pandemic.

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