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Ethnomycology of sago mushrooms (*Volvariella* sp.) in Papuan food systems

SUPENI SUFAATI[1,♥], SURIANI SURBAKTI[1], NURLITA DIANINGSIH[1], HELBERT[2], ARYANTI SICILIA PALLO[1]
[1]Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Cenderawasih. Jl. Kamp Wolker, Yabansai, Jayapura 99351, Papua, Indonesia. Tel.: +62-812-2639-0315, ♥email: penisufaati@gmail.com
[2]Research Center for Biota Systems, National Research and Innovation Agency (BRIN). Science and Techno Park of Dr. (H.C.) Ir. Soekarno, Jl. Raya Jakarta-Bogor Km. 46, Cibinong, Bogor 16911, West Java, Indonesia

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Abstract. *Sufaati S, Surbakti S, Dianingsih N, Helbert, Pallo AS. 2026. Ethnomycology of sago mushrooms (*Volvariella *sp.) in Papuan food systems. Asian J Ethnobiol 9 (1): y090123. https://doi.org/10.13057/asianjethnobiol/y090123.* This study aimed to document the ethnomycological knowledge, utilization practices, and socio-cultural roles of sago mushrooms (*Volvariella* sp.) among indigenous communities in the villages of Ifale and Maribu, Jayapura District, Papua, Indonesia. Data were collected through structured questionnaires and in-depth interviews with 41 purposively selected local knowledge holders, as well as through field observations at sago processing sites. The study examined local identification systems, culinary uses, trade, and traditional semi-cultivation practices associated with sago mushrooms growing on fermenting sago residues. The results show that all respondents recognized sago mushrooms as edible and culturally familiar food resources, with knowledge transmitted primarily through intergenerational family learning. Vernacular names varied among linguistic groups. Women played dominant roles in collecting, processing, purchasing, and exchanging mushrooms within household food systems. Sago mushrooms were commonly prepared by boiling, sautéing, or cooking in coconut milk and were perceived as beneficial for postpartum recovery and maternal health. A strong association was found between age group and selling activity ($\chi^2 = 12.84$, df = 3, p = 0.005, Cramér's V = 0.56), as well as between domicile and selling activity ($\chi^2 = 10.66$, df = 1, p = 0.001, Cramér's V = 0.51). Although sago mushrooms have economic value in local markets, their perishability limits broader commercialization. Communities also practiced semi-cultivation by intentionally retaining starch residues during sago processing to stimulate mushroom emergence. These findings demonstrate that sago mushrooms are embedded within Papuan indigenous food systems as part of a broader socio-ecological knowledge network linking sago landscapes, household subsistence, local trade, and biocultural identity. This study presents new ethnomycological insights from Papua and highlights the importance of preserving local ecological knowledge of fungal resources in tropical sago ecosystems. Further research is needed to assess postharvest storage methods, nutritional profiling, sustainable cultivation strategies, and species-level taxonomic confirmation.

Keywords: Ethnomycology, indigenous knowledge, Papua, sago mushrooms, *Volvariella* sp.

INTRODUCTION

Mushrooms are widely recognized as important non-timber forest products that contribute to local food systems, medicinal practices, and cultural identity in many indigenous communities. Their edible, medicinal, and symbolic values are often embedded within broader ecological knowledge systems and traditional land management practices. Ethnomycology, which examines human-fungi relationships in cultural and ecological contexts, plays a vital role in documenting such knowledge, particularly when it is transmitted orally across generations (Pradhan et al. 2010; Dar et al. 2023; Giri et al. 2025). As global interest in biodiverse diets and locally grounded food systems grows, ethnomycological studies are increasingly important for elucidating how local knowledge supports food practices, livelihood strategies, and biocultural continuity.

Across the world, numerous indigenous groups have long integrated wild edible mushrooms into their diets, health practices, and cultural traditions, as documented in Europe (Rakić et al. 2022), Asia (Pradhan et al. 2010; Dutta et al. 2011; Li et al. 2021; Giri et al. 2025), and the Americas (García-Montalvo et al. 2025). In Indonesia, ethnomycological studies have documented diverse uses of macrofungi in Sumatra, Kalimantan, Java, Sulawesi, and Nusa Tenggara (Fauzi et al. 2018; Khastini et al. 2018; Noverita and Setia 2019; Noverita et al. 2019; Nurhayat et al. 2021; Yusran et al. 2022, 2023, 2024a). These studies show that mushrooms are not merely gathered as seasonal foods but are also embedded in local classification systems, culinary traditions, and community-based ecological knowledge. However, research in Papua remains limited, despite the region's recognition as one of Indonesia's biodiversity hotspots, with extensive sago ecosystems that support both ecological and cultural livelihoods. Sago forests not only supply staple carbohydrates but also serve as habitats for various saprophytic fungi, including *Volvariella* spp., which local communities consume as seasonal food (Yerisetouw et al. 2023).

Volvariella is increasingly recognized for its high nutritional value, and several species of the genus have been documented from tropical and subtropical regions (Dutta et al. 2011). These mushrooms are rich in protein

and contain essential amino acids such as glutamic acid, lysine, methionine, and leucine, which complement carbohydrate-based staple diets. They are low in lipids yet rich in dietary fiber and contain bioactive compounds with anticoagulant, anti-inflammatory, and antihypertensive properties (Eguchi et al. 2015). Additionally, *Volvariella* provides important micronutrients, including potassium, phosphorus, iron, calcium, zinc, and magnesium, as well as antioxidant compounds such as phenolics (Nasir and Siva 2019).

In lowland Papua, the sago palm (*Metroxylon* spp.) holds deep sociocultural significance (Kadir et al. 2022). Among communities around Lake Sentani and Jayapura District, sago landscapes serve not only as a source of staple food and raw materials but also shape subsistence strategies, communal identity, and customary territorial management systems (Putri and Suroto 2023). During sago flour processing, residual sago pulp accumulates and ferments, forming a substrate that supports the natural growth of sago mushrooms (*Volvariella* sp.). This ecological relationship is significant because it situates sago mushrooms within a broader indigenous food landscape in which forest resources, sago processing, and household food practices are closely interconnected. Previous studies have noted that these mushrooms are edible and contain valuable nutrients (Abbas et al. 2012); however, ethnomycological knowledge regarding their use, symbolic meanings, and cultivation practices remains largely undocumented.

To date, research on sago mushrooms in Papua has focused primarily on morphological characteristics, proximate composition, and biochemical properties (Abbas et al. 2012, 2013; Yerisetouw et al. 2023). Although these studies confirm the edibility and nutritional potential of *Volvariella* sp., they do not address how local communities identify, name, manage, cook, exchange, or value these mushrooms within their socio-cultural systems. Moreover, no prior study has comprehensively documented the traditional knowledge systems governing mushroom harvesting, the gendered division of labour in collection and preparation, or the local ecological strategies used to sustain mushroom growth on sago waste substrates.

The present study documents sago mushrooms (*Volvariella* sp.) in the villages of Ifale and Maribu, Jayapura, Papua, with a focus on local knowledge of identification, growing environments, uses, subsistence, market roles, and traditional semi-cultivation. It contextualizes sago mushrooms within ecological, cultural, and livelihood frameworks, thereby contributing to the understanding of indigenous food systems and emphasizing the importance of preserving local knowledge for food security, heritage, and cultural resilience. The novelty of the study lies in its emphasis on the socio-cultural knowledge systems surrounding sago mushrooms in Papua, extending beyond taxonomic or nutritional perspectives.

MATERIALS AND METHODS

Study area

This research was conducted from May to September 2025 in the villages of Ifale and Maribu, Jayapura District, Papua, Indonesia (Figure 1). Both villages are located in lowland sago forest ecosystems, where sago (*Metroxylon* spp.) is culturally and nutritionally central to daily life. Sago processing areas (locally known as *tokok sagu*) were the primary field observation sites because sago mushrooms (*Volvariella* sp.) naturally emerge on fermenting sago pulp residues. At these sites, sago pith residues accumulate after starch extraction and remain moist, shaded, and partially decomposed. The average temperature in the area ranged from approximately 23 to 33°C, creating favourable substrate conditions for saprophytic fungal growth. During field observations, sago mushrooms were repeatedly encountered on fermenting sago pulp residues and on decaying sago trunks, which were therefore treated as the principal observation substrates in this study.

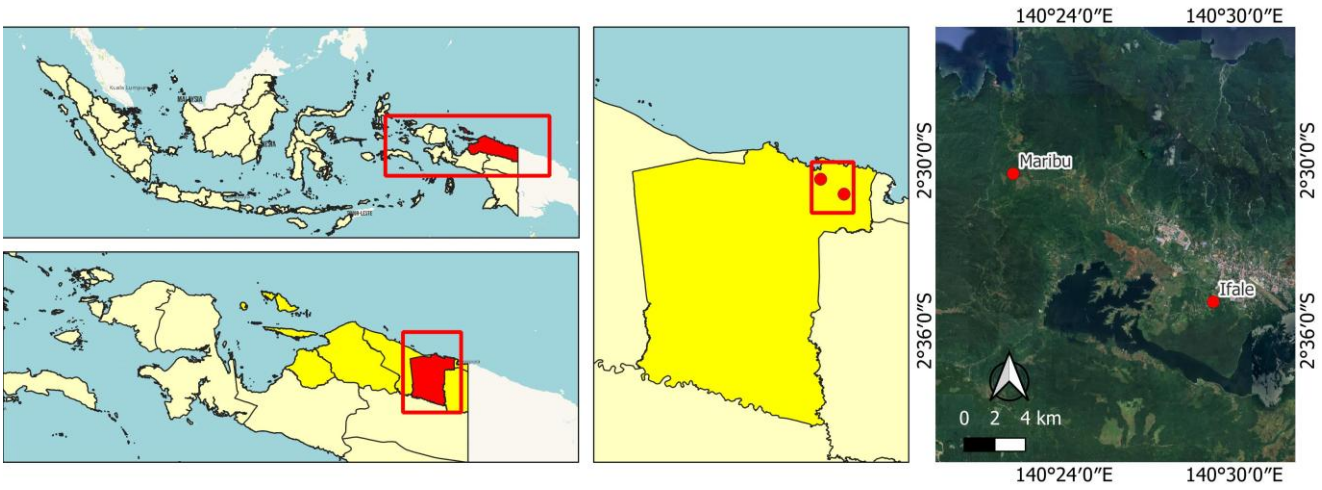

Figure 1. Ethnomycological study site in Ifale (2°34’58.038” S, 140°29’16” E) and Maribu Village (2°31’15.96” S, 140°22’12.682” E), Jayapura District, Papua, Indonesia

Study design

This study employed a socio-ethnobiological mixed-methods design in which qualitative ethnographic inquiry served as the primary approach, supplemented by descriptive and limited inferential statistics. The qualitative component documented local knowledge, naming practices, habitat recognition, culinary uses, trade, and the semi-cultivation of sago mushrooms, whereas the quantitative component summarized respondent characteristics and examined selected associations between demographic variables and mushroom-related activities. This design was chosen because ethnomycological knowledge is unevenly distributed among community members and is best documented through information-rich participants rather than through probability-based population sampling.

Ethical considerations and community permissions

This study adhered to institutional ethical guidelines and received community-level approval. Data collection followed the principles of Free, Prior, and Informed Consent (FPIC). Before interviews, research aims, confidentiality, and the voluntary nature of participation were explained, and verbal consent was obtained from all participants. Village leaders and clan elders granted permission to conduct research within communal territories. Institutional ethical clearance was provided by the Research Ethics Committee of the Institute for Research and Community Service of Universitas Cenderawasih (090a/UN20.2.1/PG/2025).

Sampling and respondents

This study used purposive and snowball sampling to identify individuals with relevant ethnomycological knowledge of sago mushrooms (*Volvariella* sp.). Because traditional ecological knowledge is unevenly distributed within indigenous communities, non-probability sampling was considered appropriate to ensure the inclusion of participants directly engaged in sago-related practices rather than randomly selected community members.

A purposive sampling approach was used to select participants with direct knowledge of, or involvement in, sago mushroom gathering, cooking, cultivation, or trade. Initial key informants, including village elders, sago processors, and mushroom collectors, were identified through recommendations from community leaders. Snowball sampling was then applied to identify additional local knowledge holders, with each informant recommending individuals considered knowledgeable about the use of sago mushrooms and related cultural practices. Recruitment proceeded iteratively until informational saturation was achieved, defined as the point at which additional interviews yielded repetitive responses and no substantially new ethnomycological information emerged.

A total of 41 respondents participated, representing diverse age groups, genders, ethnic backgrounds, household occupations, villages of residence, and periods of residence. This sampling strategy ensured the inclusion of individuals actively engaged in local sago food systems. The adequacy of this sample size was justified by qualitative research principles that prioritize knowledge saturation over numerical representativeness. Previous ethnomycological and ethnobiological studies in comparable community-based contexts commonly employ sample sizes of 30 to 50 knowledgeable participants to reliably document traditional ecological knowledge (Oag and Em 2018; Asiimwe et al. 2021; Rahman et al. 2023). In the present study, thematic repetition across interviews indicated that the diversity of local knowledge regarding identification, harvesting practices, culinary use, and semi-cultivation of sago mushrooms had been sufficiently captured. The final sample size was therefore considered adequate to support robust qualitative interpretation while allowing complementary quantitative analysis of respondent characteristics and utilization patterns.

The marked gender imbalance in the respondent pool (3 men and 38 women) was intentional rather than incidental. During preliminary field engagement and key-informant consultation, women were consistently identified as the primary actors in collecting, cleaning, cooking, and locally exchanging sago mushrooms, and were therefore more frequently recognized as the principal knowledge holders for the daily use and handling of these mushrooms. This gendered division of labour accordingly shaped the final composition of respondents.

The structured questionnaire comprised five domains, such as (i) demographic characteristics, (ii) knowledge and identification of sago mushrooms, (iii) consumption and uses, (iv) collection and trade practices, including postharvest handling, and (v) semi-cultivation knowledge and practices (Table 1).

Data collection

Data were collected from May to September 2025 using three complementary techniques, such as (i) structured questionnaires, (ii) semi-structured in-depth interviews, and (iii) participant observation. The questionnaire covered demographic information, knowledge of mushroom identification and ecology, culinary and medicinal uses, and practices related to collection, trade, storage, and cultivation. Semi-structured interviews were conducted with selected key informants, including village elders, sago processors, women involved in household food preparation, and local traders. These interviews explored traditional knowledge of mushroom identification and use, intergenerational knowledge transmission, harvesting practices, local trade systems, and habitat management.

Interview responses were transcribed, coded, and grouped into thematic categories, including mushroom identification, ecological knowledge, utilization practices, cultivation techniques, economic value, and cultural perceptions. Similar responses were clustered to identify recurring patterns and differences among informants. To ensure data validity, information from interviews was cross-checked through participant observation, field documentation, and comparison with questionnaire responses. Triangulation across data sources and informant groups was used to verify the consistency and reliability of reported knowledge and practices. Repeated discussions

with key informants were held when clarification was required, and field notes, photographs, and narrative descriptions were used to contextualize responses and validate reported practices.

Identification of mushroom specimens

The sago mushroom was identified as *Volvariella* sp. based on morphological features, including cap shape and colour, presence of a volva, and gill structure, using regional mycological keys (Seok et al. 2002; Dutta et al. 2011; Vizzini et al. 2011; Abbas et al. 2012; Kumla et al. 2022). Representative specimens were photographed, and reference photo vouchers were deposited in the Mycology Laboratory, Faculty of Mathematics and Natural Sciences, Universitas Cenderawasih (code: SMIf 01), enabling future taxonomic verification. Identification was intentionally retained at the genus level because this community-based field study did not include full microscopic examination or molecular confirmation. Accordingly, the manuscript consistently refers to the collected material as *Volvariella* sp. rather than assigning a species name that could not be robustly confirmed.

Table 1. Questionnaire administered to 41 respondents to assess knowledge of and use of sago mushrooms

Domain	Variable/Question	Response format
Demographic characteristics	Respondent code	Open-ended (name)
	Age (years)	Open ended, later categorized for analysis
	Sex	1 = Male, 2 = Female
	Educational background	1 = No formal education, 2 = Primary school, 3 = Junior high school, 4 = Senior high school, 5 = Diploma/Bachelor's degree
	Occupation	1 = Farmer, 2 = Trader, 3 = Civil servant, 4 = Teacher, 5 = Housewife, 6 = Other
	Ethnic group	Open-ended
	Place of residence	1 = Maribu, 2 = Ifale
	Length of residence in the village	Open-ended (years)
Knowledge and identification of sago mushrooms	Do you know about sago mushrooms?	1 = Yes, 2 = No
	Have you ever seen sago mushrooms directly?	1 = Yes, 2 = No
	What is the typical shape of sago mushrooms?	1 = Egg-shaped, 2 = Umbrella-shaped
	Where do sago mushrooms usually grow?	1 = Sago waste residue, 2 = Dead sago trunks, 3 = Living sago trees, 4 = Dried sago leaves, 5 = Other
	Are there particular types of sago trees that host sago mushrooms?	Open-ended
	When do sago mushrooms grow in abundance?	Open-ended
	What is the local name of sago mushrooms?	Open-ended
Consumption and uses	Are sago mushrooms edible?	1 = Yes, 2 = No
	How do you know that sago mushrooms are edible?	Open-ended
	Have you ever eaten sago mushrooms?	1 = Yes, 2 = No
	Do you like eating sago mushrooms?	1 = Yes, 2 = No
	Have you ever cooked sago mushrooms?	1 = Yes, 2 = No
	How are sago mushrooms usually prepared or cooked?	Open-ended
	Are sago mushrooms served during traditional ceremonies?	1 = Yes, 2 = No
	Are there other uses of sago mushrooms, for example medicinal uses?	Open-ended
	Do you know the nutritional content or nutritional benefits of sago mushrooms?	1 = Yes, 2 = No
	Has anyone ever experienced poisoning after eating sago mushrooms? If yes, how was it treated?	Open-ended
Collection, trade, and postharvest handling	Do you collect sago mushrooms?	1 = Yes, 2 = No
	Do you sell sago mushrooms?	1 = Yes, 2 = No
	Where are sago mushrooms sold?	Open-ended
	What is the price of sago mushrooms per bundle?	Open-ended
	How are sago mushrooms stored to prolong freshness?	Open-ended
	Do you buy sago mushrooms?	1 = Yes, 2 = No
Semi-cultivation knowledge and practice	Do you know how to cultivate sago mushrooms?	1 = Yes, 2 = No
	Have you ever cultivated sago mushrooms?	1 = Yes, 2 = No
	Do you know the traditional methods used to cultivate or encourage the growth of sago mushrooms?	Open-ended
	Do you know the main challenges in cultivating sago mushrooms?	Open-ended

Data analysis

Data analysis combined qualitative ethnomycological interpretation with quantitative statistical analysis to examine relationships between demographic characteristics and patterns of knowledge and use of sago mushrooms (*Volvariella* sp.).

Qualitative interview data were analyzed using thematic coding, involving the following steps: transcription of recorded interviews, open coding to identify key concepts, grouping of codes into broader themes (e.g., knowledge transmission, culinary practice, gender roles, and ecological management), and triangulation of interview data, participant observation, and relevant literature to ensure validity and interpretive reliability.

Quantitative questionnaire data were tabulated in Microsoft Excel and analyzed using descriptive statistics (frequencies and percentages). To assess associations between demographic variables and participation in mushroom collection and selling, chi-square tests were conducted in SPSS v.16, with significance set at $p < 0.05$. Chi-square tests and Cramér's V were selected because the demographic and ethnomycological variables were categorical and the analysis aimed to determine whether participation patterns differed significantly across social groups.

More advanced multivariate analyses, such as regression modeling, were not applied because the study was designed as a community-based ethnomycological assessment with a relatively small, non-probabilistic sample that emphasized knowledgeable participants rather than population-level prediction. Because several categories contained sparse cell counts, expected frequencies were reviewed prior to interpretation, and inferential results were treated as exploratory and interpreted with caution where data were unevenly distributed. Statistical findings were therefore interpreted alongside qualitative evidence to provide a comprehensive understanding of knowledge transmission and utilization patterns.

RESULTS AND DISCUSSION

Demographic characteristics of respondents

A total of 41 respondents participated in this study, comprising 3 men (7%) and 38 women (93%). Respondents were distributed across four age groups: 40-50 years (34%), over 50 years (25%), 30-40 years (24%), and 20-30 years (17%). The majority had completed senior high school (68%), while some had graduated from college (15%), and others had completed only junior high school, elementary school, or had no formal education. The main occupations were farmers (44%), housewives (24%), teachers (12%), and small-scale traders (10%). Most respondents identified as members of the Sentani, Maribu, and Banundi communities (Figure 2), and the majority had lived in their villages for more than 20 years. These demographic characteristics indicate that the respondent pool consisted mainly of long-term residents with close engagement in sago-based livelihoods, which is relevant because the observed patterns of use, exchange, and knowledge transmission are strongly linked to gender, residence, and ethnicity.

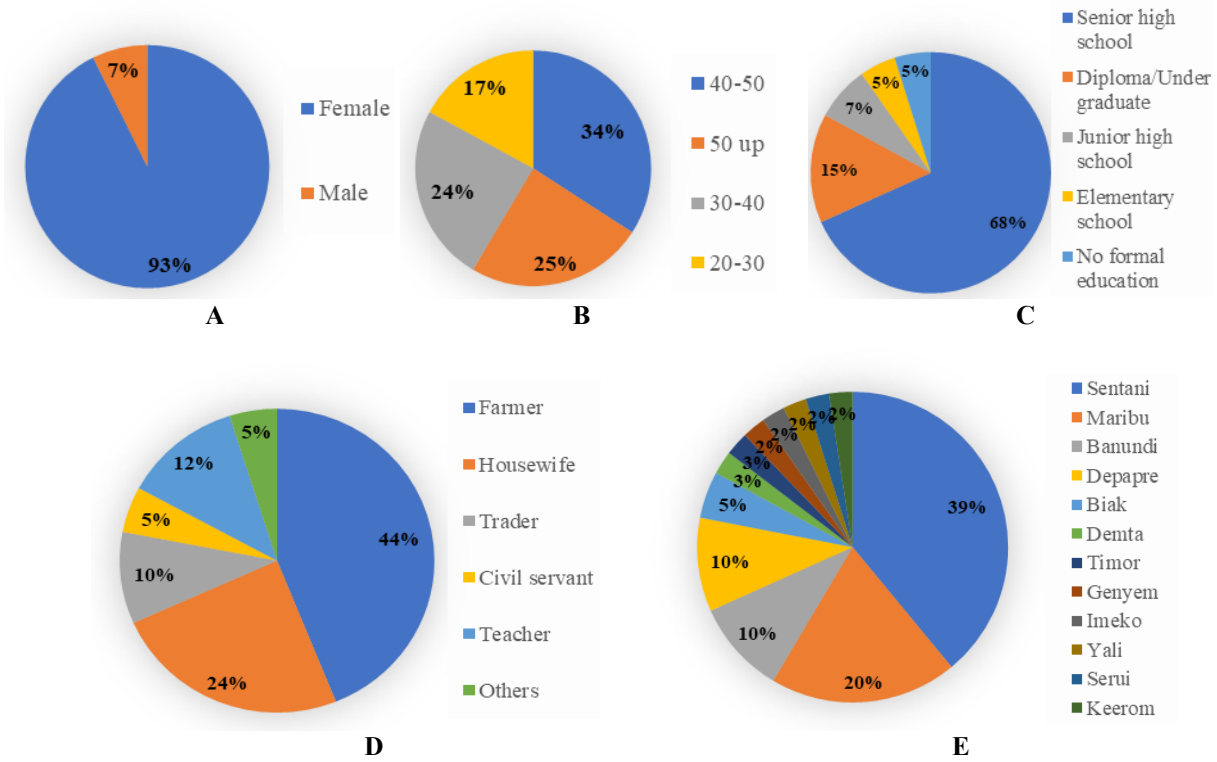

Figure 2. Demographic data of the respondents: A. Gender, B. Age, C. Education, D. Occupation, and E. Ethnic group

Knowledge and identification of sago mushrooms

All respondents (100%) were familiar with sago mushrooms and had directly observed them in sago forests or processing sites, with knowledge transmitted primarily through intergenerational family learning (92.7%). Mushrooms were described as egg-shaped when young and umbrella-shaped when mature, with a soft texture and a pale to greyish cap, growing predominantly on fermenting sago pulp residues or on felled sago trunks (Figure 3). They may emerge on all types of sago palms, and peak availability was reported during the rainy season.

Local names varied among linguistic groups, including *kanak krabut* (Maribu), *fendlung* (Sentani), *yambuk kruap* (Genyem), and *pi oko* (Demta). The naming logic used by respondents was closely associated with ecological context, morphology, and familiarity with the growth substrate. Several respondents associated the mushroom with decomposing sago residues or decaying sago trunks, indicating that local classification was not based solely on morphological appearance but also on habitat association. For example, the Genyem tribe referred to the sago mushroom as *yambuk kruap* (*yambuk*: sago; *kruap*: mushroom). This reflects a folk-taxonomic system in which organisms are categorized according to observable ecological relationships, practical use, and repeated interaction within everyday subsistence activities.

Consumption and uses

All respondents (100%) reported consuming sago mushrooms. Several field-recognized characteristics were used to identify edible sago mushrooms and distinguish them from undesirable fungi. Mushrooms were consistently recognized by their pale white to greyish cap, soft texture, smooth surface, and emergence on fermenting sago residues or decaying sago trunks. Local communities emphasized that edible sago mushrooms typically grow in clustered formations on moist sago-processing waste and are most abundant shortly after rainfall; habitat association was therefore considered one of the most important identification criteria. Respondents also relied on developmental stage and freshness as indicators of edibility. Freshly harvested mushrooms were identified by their firm structure, intact cap surface, and absence of strong unpleasant odours, while mushrooms appearing slimy, water-soaked, or partially decomposed were generally avoided. Both the egg and mature stages were consumed, and no respondents reported poisoning.

The most common preparation methods were boiling and eating with sago congee (*papeda*), sautéing with spices, and cooking in coconut milk (Figure 4). Although sago mushrooms are not always associated with traditional ceremonies, respondents indicated that they play an important role in local cuisine and household food practices. A total of 43.9% of respondents reported that sago mushrooms were perceived as beneficial for certain health-related conditions, and 22.0% specifically noted their perceived role in supporting the stamina of pregnant, postpartum, and breastfeeding women. This finding should be interpreted as reflecting respondents' perceptions and local dietary beliefs rather than as biomedical validation of therapeutic efficacy.

Figure 4. The culinary of sago mushroom (*Volvariella* sp.): A. Egg-shaped and mature sago mushrooms ready to cook, B. Mature sago mushrooms cooked with coconut milk, C. Sago mushroom curry served with *papeda* (sago congee)

Figure 3. A. Morphology of sago mushroom (*Volvariella* sp.) from left to right: button stage, egg shape, elongation, mature stage, and fully expanded cap. B. Sago mushroom naturally growing on sago waste

Collection, trade, and postharvest handling

A total of 29 respondents (70.7%) reported collecting sago mushrooms, whereas only 11 (26.8%) reported selling them. Sago mushrooms were sold at local markets for Rp25,000 to Rp40,000 per bundle (approximately 250 g) (Figure 5). Respondents consistently noted that the mushrooms have a very short shelf life of approximately 24 hours, requiring rapid consumption or sale after harvesting. To maintain freshness, respondents described several storage methods, including wrapping the mushrooms in banana, taro, or sago leaves; keeping them in shaded areas; and refrigerating them when possible.

The participation patterns shown in Table 2 reveal clear socio-economic contrasts between Ifale and Maribu villages rather than mere differences in frequency of participation. Although respondents from both villages were actively involved in collecting sago mushrooms, the most pronounced contrast emerged in selling activities. Maribu respondents were predominantly engaged in subsistence-oriented collection, with only 2.4% participating in selling, whereas respondents from Ifale showed substantially higher market participation (24.4%). This difference was statistically significant ($\chi^2 = 10.66$, df = 1, $p = 0.001$, Cramér's V = 0.51), indicating that domicile strongly influenced commercial involvement in sago mushroom use.

This contrast suggests that sago mushrooms fulfil somewhat different socio-economic roles in the two villages. In Maribu, mushrooms appear to function primarily as household food resources embedded within subsistence practices and local consumption, whereas in Ifale, communities were more actively connected to small-scale market exchange, indicating stronger integration of sago mushrooms into local cash-generating activities. The higher selling participation in Ifale may reflect better market accessibility, proximity to trading routes, or stronger engagement with roadside and traditional market systems around Sentani.

Middle-aged respondents (40-50 years) showed the highest participation in collecting, selling, and buying activities, whereas younger respondents (20-30 years) were minimally involved, particularly in selling. The significant association between age group and selling activity ($\chi^2 = 12.84$, df = 3, $p = 0.005$, Cramér's V = 0.56) suggests that the economic dimension of sago mushroom use is concentrated among mature adults who remain strongly engaged in traditional subsistence and trade networks. The low involvement of younger generations may indicate a gradual weakening of participation in local ethnomycological practices.

Tribal differences observed in Table 2 also suggest uneven integration of sago mushrooms into local livelihood systems. Respondents from the Sentani tribe showed the strongest engagement across collecting, selling, and buying categories, whereas smaller ethnic groups participated mainly as consumers rather than traders. However, because several ethnic categories were represented by only a few respondents, these patterns should be interpreted descriptively rather than as generalized ethnic differences.

Table 2. Participation of respondent groups in collecting, selling, and buying sago mushrooms in Ifale and Maribu Villages, Jayapura District, Papua, Indonesia

Category	Informant group	Collecting, n (%)	Selling, n (%)	Buying, n (%)
Gender	Men	0 (0.0)	0 (0.0)	3 (7.3)
	Women	29 (70.7)	11 (26.8)	38 (92.7)
Tribe/origin	Banundi	3 (7.3)	0 (0.0)	4 (9.8)
	Biak	0 (0.0)	0 (0.0)	2 (4.9)
	Demta	1 (2.4)	0 (0.0)	1 (2.4)
	Depapre	4 (9.8)	1 (2.4)	4 (9.8)
	Genyem	1 (2.4)	0 (0.0)	1 (2.4)
	Imeko	1 (2.4)	0 (0.0)	1 (2.4)
	Maribu	5 (12.2)	1 (2.4)	8 (19.5)
	Sentani	13 (31.7)	9 (22.0)	16 (39.0)
	Serui	0 (0.0)	0 (0.0)	1 (2.4)
	Timor	0 (0.0)	0 (0.0)	1 (2.4)
	Keerom	0 (0.0)	0 (0.0)	1 (2.4)
	Yali	1 (2.4)	0 (0.0)	1 (2.4)
Age group (years)	20-30	4 (9.8)	0 (0.0)	7 (17.1)
	30-40	9 (22.0)	3 (7.3)	10 (24.4)
	40-50	9 (22.0)	8 (19.5)	14 (34.1)
	≥50	7 (17.1)	0 (0.0)	10 (24.4)
Domicile	Maribu	16 (39.0)	1 (2.4)	21 (51.2)
	Ifale	13 (31.7)	10 (24.4)	20 (48.8)

Note: Values are presented as n (%), with percentages calculated based on the total number of respondents (N = 41). Tribal comparisons are descriptive only

Figure 5. Sago mushroom (*Volvariella* sp.) and other commodities, such as sago worm and edible fern, were sold at old traditional market, Sentani, Papua, Indonesia

Traditional cultivation practices

Respondents described a semi-cultivation method in which sago starch is intentionally retained during processing to promote mushroom growth on the resulting pulp. The substrate is commonly stacked and covered with sago leaves to maintain humidity, and sago mushrooms were reported to emerge naturally after approximately two months. This finding indicates that local communities do not merely harvest mushrooms opportunistically but also manipulate substrate conditions to encourage future emergence. The practice is therefore better understood as semi-cultivation rather than full domestication.

Discussion

In both Ifale and Maribu, knowledge about sago mushrooms is acquired primarily through everyday participation in sago-related activities, with respondents commonly describing learning from parents or older relatives while collecting, processing, or preparing food. The complete familiarity of respondents with sago mushrooms indicates that this species is regarded not as an incidental forest resource but as a culturally recognized and stable component of the local food system. The ethnomycological patterns documented in Jayapura also show important parallels with fungal-use traditions reported from eastern Indonesia, Melanesia, and other tropical wetland communities. Similar patterns of inherited mycological knowledge have been documented among indigenous communities in Central Sulawesi, Brazil, Mexico, South Asia, and Papua New Guinea, where edible mushrooms are integrated into both food practices and cultural identity (Treu and Adamson 2006; Álvarez-Farias et al. 2016; Wang et al. 2022; Dar et al. 2023; Yusran et al. 2023; Jeronimo et al. 2024). In the Papuan context, the presence of distinct vernacular names across language groups suggests that familiarity with sago mushrooms is widespread and has long been integrated into local cultural traditions.

Women were the principal actors in most mushroom-related activities, particularly collecting, cleaning, cooking, and household exchange, and consequently possessed more detailed practical knowledge regarding harvesting conditions, freshness, and preparation techniques. Rather than treating this pattern solely as a demographic observation, it is more appropriate to understand it as a form of gendered ecological expertise. In sago-based livelihoods, women are closely involved in food provisioning and in the practical observation of ecological cues, such as the condition of sago residues, humidity levels, and the early emergence of mushrooms. This aligns with ethnobiological scholarship showing that women often act as custodians of food-related ecological knowledge because of their roles in household subsistence and daily resource management (Zeleke et al. 2020; Hussain et al. 2023). The role of women in this study therefore extends beyond cooking and trade to include the maintenance and transmission of practical knowledge that sustains local mushroom use.

The comprehensive engagement of respondents with sago mushrooms attests to their significance as a dietary staple, extending well beyond their classification as mere wild food. Other ethnomycological studies similarly report that several ethnic groups are mycophilic (Zeleke et al. 2020; Ríos-García et al. 2023; Jeronimo et al. 2024). The culinary use of sago mushrooms reflects notable flexibility, enriching Papua's regional cuisine. From an ethnogastronomic perspective, food selection is shaped not only by availability but also by taste, texture, habit, and cultural acceptability. The perception among some respondents that sago mushrooms are beneficial for pregnant, postpartum, and breastfeeding women is also ethnobiologically significant, although this should be understood as a culturally grounded dietary belief rather than direct biomedical evidence. Previous literature supports the broader nutritional relevance of edible mushrooms (Eguchi et al. 2015; Nasir and Siva 2019; Bell et al. 2022), and the present study contributes by documenting their place in everyday diets and local systems of care.

Selling activity was dominated by respondents aged 40-50 years, whereas younger participants were rarely involved in market exchange. This does not in itself confirm complete knowledge loss, but it suggests that younger generations may be less engaged in the economic and practical dimensions of the sago mushroom knowledge system than their middle-aged counterparts. Similar concerns about generational decline in ethnobiological knowledge have been reported in Indonesia and elsewhere (Khastini et al. 2018; Hussain et al. 2023). For Papua, such decline would not only affect mushroom use but would also weaken the sago-based food heritage and ecological knowledge associated with it. Educational initiatives, culinary revitalization, and participatory postharvest research may help support the transmission of this knowledge among younger community members while keeping it rooted in local cultural practice (Jeronimo et al. 2024; Sufaati et al. 2024).

The short shelf life of sago mushrooms presents challenges for market expansion, as respondents noted that they must be consumed or sold within 24 hours of harvest. Nevertheless, rather than eliminating economic value entirely, perishability shapes the structure of local trade systems through which sago mushrooms are exchanged. In Jayapura, sago mushroom marketing operates primarily through short supply chains, with direct sales among collectors, household consumers, and nearby village or roadside markets. This proximity-based trade minimizes storage requirements and reduces dependence on transport infrastructure, enabling the mushrooms to retain local value despite limited durability. Similar constraints have been noted in other wild edible mushroom trade systems, where perishability limits transport distance and broader commercialization (Castellanos-Reyes et al. 2021). Other studies likewise report that wild edible mushrooms are commonly marketed at traditional markets close to communities, including in West Papua, Sulawesi, and Mexico (Ruán-Soto et al. 2006; Suharno et al. 2014; Álvarez-Farias et al. 2016; Yusran et al. 2024b). The continued sale of sago mushrooms in local markets therefore indicates that their value is sustained through

seasonal demand, cultural familiarity, and short-range exchange rather than through extended commercial chains.

The study also highlights a traditional semi-cultivation system in which sago starch is intentionally retained during processing to promote fungal growth. Although mushrooms are not cultivated under controlled conditions, local communities actively manage the substrate by retaining moist sago residues and covering them with leaves to encourage future growth. Comparable practices have been described among communities managing wild edible mushrooms, including *Volvariella speciosa* and *Termitomycetes* sp., in Uganda, where fungal productivity is enhanced by manipulating substrate conditions (Wendiro et al. 2019). Sago mushroom cultivation in Papua can therefore be viewed as a form of agro-ecological knowledge embedded within customary land-use systems. This represents one of the principal contributions of the present manuscript, given that previous studies on sago mushrooms in Papua have emphasized morphology and nutrient composition rather than socio-cultural management practices.

In conclusion, this study provides a comprehensive ethnoecological account of sago mushrooms (*Volvariella* sp.) in Ifale and Maribu Villages, Jayapura District, Papua. Knowledge of mushroom identification, seasonality, and suitable growth substrates is transmitted primarily within households and sustained through repeated engagement in sago-based livelihoods. The dominant role of women in collecting, preparing, and purchasing sago mushrooms attests to the importance of gendered knowledge in sustaining local food systems. Traditional semi-cultivation practices, which involve managing sago waste to promote mushroom growth, constitute a form of ecological stewardship and local resource management rather than mere opportunistic gathering. However, the mushrooms' short shelf life and the lower participation among younger respondents indicate that this knowledge system is vulnerable to erosion. Future efforts should therefore focus on strengthening community-based knowledge transmission, improving postharvest handling, and supporting further research into species-level identification and locally appropriate semi-cultivation techniques.

Beyond documenting local mushroom use, this study contributes to broader efforts in biodiversity documentation and the preservation of indigenous ecological knowledge in Papua. Tropical fungal diversity remains poorly documented relative to plant and animal resources, particularly in eastern Indonesia and Melanesian regions where ethnomycological research is still limited. By recording vernacular classification systems, habitat recognition, harvesting practices, and semi-cultivation techniques associated with *Volvariella* sp., this study provides baseline ethnobiological information that complements existing taxonomic and nutritional research on Papuan fungi. Sago-processing landscapes function not only as sites of starch production but also as ecological niches supporting fungal diversity and seasonal food resources. Recognition of these socio-ecological relationships may support future community-based conservation initiatives, sustainable food programs, and locally grounded approaches to wetland resource management in Papua and other tropical regions.

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