



## Consumption of the *Elaeocarpus hygrophilus* Kurz Fruit in Cambodia: An Exploratory Study

**SOTHEA KONG\***

Graduate School, Royal University of Agriculture, Phnom Penh, Cambodia  
Graduate School of Bioagricultural Sciences, Nagoya University, Nagoya, Japan  
Email: kong\_sothea@yahoo.com

**HISAKO NOMURA**

Faculty of Agriculture, Kyushu University, Japan

**TAMON BABA**

College of Letters, Ritsumeikan University, Japan

**HIROYUKI HATTORI**

Graduate School of Bioagricultural Sciences, Nagoya University, Nagoya, Japan  
Asian Satellite Campus Institute, Nagoya University, Nagoya, Japan

**SAMNANG NGUON**

Graduate School, Royal University of Agriculture, Phnom Penh, Cambodia

**KASUMI ITO**

International Center for Research and Education in Agriculture, Nagoya University, Japan

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**Abstract** In Cambodia, most historical materials have been lost due to the genocide and the book-burning policy under the Pol Pot regime, and therefore, limited scientific records of the names, raw materials, manufacturing methods, and ingredients of traditional foods exist today. Current changes in the Cambodian lifestyle, such as the westernization of eating habits and increased food safety awareness, are driving factors that may result in the gradual disappearance of traditional foods. The *Elaeocarpus hygrophilus* Kurz fruit, known as *Madenh* or *Romdenh* in Khmer, is one example of a traditional food under pressure from changing eating habits. This study aimed to identify the consumption trends of *Elaeocarpus hygrophilus* Kurz and its processed products. The field survey revealed six ways of eating *Elaeocarpus hygrophilus* Kurz, including pickled, smashed-in-sugar, raw, caramelized, pickled-in-honey, and pickled-in-rice liquor. Additionally, the results of interviews with 514 customers in the local market about their habits regarding the product showed that younger customers tended to consume more pickled, smashed-in-sugar, and fresh fruit than the older generations. Further studies on the nutritional content of these products are needed to explore their relationship with eating habits and to prevent the decline in traditional food preferences.

**Keywords** *Elaeocarpus hygrophilus* Kurz, consumption trend, Cambodia, traditional foods

### INTRODUCTION

From ancient times, Khmer residents used a variety of indigenous foods in their staple diets, including rice, fish, fruits, edible flowers, a pungent fermented paste called *Prohoc*, and fermented alcoholic beverages (Tully, 2005). Although these foods are an important aspect of Cambodia's national culture, they are mostly served only in traditional festivities such as Phcum Ben and the Khmer New Year, or weddings and funerals (Deth et al., 2020). The daily eating habits and traditional processing methods of the ubiquitous *Prohoc* and fermented alcoholic wines have been visibly

passed from generation to generation. For example, most Cambodian residents living in rural areas frequently catch fish from the Tonlé Sap Lake and nearby streams during the pick seasons to process *Prohoc* (LeGrand et al., 2020). The Ethnic Khmer groups including Khmer Khork, Suoy, Kuy, Kroung, Kravet, Lun, Tampuan, Phnong, and Kachok residing in the northern-eastern part of Cambodia still use traditional homemade starter culture for making fermented rice (*Tapae* in Khmer), rice liquor, and palm liquor (Yamamoto and Matsumoto, 2011). The local varieties of fermented (pickled) vegetables such as cucumber, mustard green, carrot, bean sprouts, cabbage, and daikon radish are popular (Chrun et al., 2017). The types of fermented meat include fish sauce, fish paste, shrimp paste, sour fermented paste, and salted fish, among others (Ly et al., 2020). One of the major fruit products in Cambodia is a pickled olive-like green fruit called *Madenh* or *Romdenh* in Khmer. In Cambodia, the scientific name *Planchonella obovata* is often used for this fruit and tree because the local Khmer-English dictionary uses the name. However, this paper uses the scientific name *Elaeocarpus hygrophilus* Kurz as the result of identification by herbarium specimen using samples from several provinces in Cambodia<sup>1)</sup>.

The fruit is mostly harvested from flooded areas and Cambodian people commonly use it as a traditional remedy, with pregnant women in particular consuming it after baby delivery to improve blood circulation (Dy, 2000). In Vietnam, the *Elaeocarpus hygrophilus* Kurz fruit is processed through fermentation, into jam, and pickled with rice wine; these products are highly consumed by rural and urban Vietnamese people because of the specific taste (Giang, 2023). In Thailand, it is used as a traditional medicine for reducing body overheating and stimulating saliva secretion (Kuria et al., 2021). Although these products are widely sold at wet markets in Cambodia and highly consumed, the available varieties and consumption trends of the fruit have not yet been examined. In particular, current changes in the Cambodian lifestyle, including the Westernization of eating habits and increased awareness of food safety, are enhancing the risk that such traditional foods may disappear unnoticed.



**Fig. 1** *Elaeocarpus hygrophilus* Kurz tree and related products

## OBJECTIVE

This study aimed to identify the existing varieties and consumption trends of the *Elaeocarpus hygrophilus* Kurz fruit products in Cambodia by examining the consumption habits and demographic characteristics of Cambodian residents.

## METHODOLOGY

A total of 514 participants were selected from 25 provinces in Cambodia, covering two markets per province and at least 10 to 12 customers per market. Face-to-face interviews were conducted from September to October 2022.

A two-pronged analysis method was employed. First, descriptive statistics were used to explore the respondents' demographics – age group, gender, religion, and nationality; motives – sensory characteristics and product type awareness; consumption habits – product types, eating location, and occasion; and the consumption frequency of *Elaeocarpus hygrophilus* Kurz products. Second, ordered probit models were used to investigate the relationship between consumption frequency and participants' demographics, consumption habits, and motives for consuming *Elaeocarpus hygrophilus* Kurz products. These models were not used for interpreting the consumption frequencies (never, low, medium, and high); therefore, marginal effects were used to predict the probability of such levels.

Before starting the ordered probit models, the main variables of demographics, consumption habits, and motives, which were included as dummy variables and displayed as independent variables, were examined carefully for multicollinearity with the consumption frequency (dependent variable) of *Elaeocarpus hygrophilus* Kurz products; if the values of variance-inflating factors (VIF) are higher than 5 to 10, multicollinearity might occur among the independent variables in the regression models. However, in this study, the VIF values with the ordered probit model were between 1 and 1.81, which was acceptable (Shrestha, 2020). Therefore, the final suitable independent variables used after checking VIF included demographics – age groups (Age 1–Age 5), gender – product type, eating location, occasion (Pchum Ben, Khmer New Year, wedding, water festival, and recreation), and motives (taste, smell, color, appearance, and health benefit), independently.

Consumption frequency (dependent variable) was measured on a scale from “0” (never) to “high” (every day or two to three times per week; low = once every three months or one to two times a year; medium = once per week or month). This scale was further used to measure the consumption of four popular products of *Elaeocarpus hygrophilus* Kurz fruit, including fresh, pickled, smashed-in-sugar, and caramelized. Thus, the ordered probit models generalized the consumption frequency of each product by changing a unit whenever an independent variable unit increased or decreased. Age 6 and Age 7 showed high collinearity; therefore, they were excluded from the ordered probit models. A detailed description of the variables is presented in Table 1.

According to Lanfranchi (2019), the ordered probit model was formed as follows Eq. (1).

$$y_i^* = \beta x_i + \varepsilon_i \quad (1)$$

Where  $y_i^*$  is an unobserved dependent continuous variable (consumption frequency) of  $i$  ( $i = 0$  (never), 1 (low), 2 (medium), 3 (high)),  $x_i$ , a matrix of known values of independent explanatory variables (demographics, consumption habits, and motives of respondents),  $\beta$  is a vector of unknown slope parameters to be estimated, and  $\varepsilon_i$ , a vector of stochastic error-term (standard normal distribution). The variable  $y$  is observable and the relationship between  $y$  and  $\mu_i$  is referred to as the threshold point function (cut-off points;  $y_i^*$ ) that is predicted along with the regression coefficient.

Consumption frequency ( $y = 0, 1, 2, 3$ ) was determined following Eq. (2).

$$y = 0 \text{ if } y^* \leq 0, y = 1 \text{ if } 0 \leq y^* \leq \mu_1, y = 2 \text{ if } \mu_1 \leq y^* \leq \mu_2, \text{ and } y = 3 \text{ if } y^* \leq \mu_2 \quad (2)$$

Where  $\mu_1$  and  $\mu_2$ , ( $0 < \mu_1 < \mu_2$ ) are threshold parameters of  $y^*$  that are predicted with  $\beta$ . The form of probability of consumption frequency was estimated according to Eq. (3):

$$Prob(y=0) = \Phi(-\beta x), Prob(y=1) = \Phi(\mu_1 - \beta x) - \Phi(-\beta x), \dots, prob(y=3) = 1 - \Phi(\mu_2 - \beta x) \quad (3)$$

Where  $\Phi$  is the normal cumulative distribution function. The ordered probit model was predicted by using maximum likelihood estimation (Gebre and Rahut, 2021). The interpretation was based on the  $\beta$  parameters through the independent variable impact on consumption frequency. In the post-estimation, marginal effects were used to estimate the different scales of consumption frequency levels by estimating a change in its probability concurrently with a change in the unit of an independent variable (Cantillo et al., 2021). All data were analyzed using the STATA version 13 statistical software.

**Table 1 Variable description**

Type of variable	Description of variable	Proportion mean	SD
Dependent variable			
Food consumption frequency	0 = never; 1 = low; 2 = medium; 3 = high		
Independent variable			
Demographics			
Age1	1 = if age is less than 19 years; 0 = otherwise	7.00 %	0.25
Age2	1 = if age is between 20–29 years; 0 = otherwise	18.00 %	0.38
Age3	1 = if age is between 30–39 years; 0 = otherwise	20.00 %	0.40
Age4	1 = if age is between 40–49 years; 0 = otherwise	15.00 %	0.36
Age5	1 = if age is between 50–59 years; 0 = otherwise	9.00 %	0.29
Age6	1 = if age is between 60–99 years; 0 = otherwise	24.00 %	0.43
Age7	1 = if age is more than 70 years; 0 = otherwise	4.00 %	0.20
Gender	1 = male; 0 = otherwise	25.00 %	0.43
Consumption habit			
Production type	1 = if consumer processes <i>Elaeocarpus hygrophilus Kurz</i> themselves; 0 = otherwise	1183.00 %	10.61
Eating location	1 = if consumer eats such products at home; 0 = otherwise	8517.00 %	89.24
Occasion festivities			
Pchum Ben	1 = if consumed during Phcum Ben festival; 0 = otherwise	7417.00 %	85.67
Khmer New Year	1 = if consumed during Khmer New Year; 0 = otherwise	1567.00 %	19.85
Wedding	1 = if consumed during wedding; 0 = otherwise	1133.00 %	11.94
Water festival	1 = if consumed during water festival; 0 = otherwise	2300.00 %	26.20
Recreation	1 = if consumed during recreation; 0 = otherwise	9283.00 %	98.66
Motives			
Taste	1 = if taste is important; 0 = otherwise	87.00 %	0.33
Smell	1 = if smell is important; 0 = otherwise	7.00 %	0.25
Color	1 = if color is important; 0 = otherwise	4.00 %	0.21
Appearance	1 = if appearance is important; 0 = otherwise	29.00 %	0.45
Health benefit	1 = if health is important; 0 = otherwise	4.00 %	0.19

## RESULTS AND DISCUSSION

Table 2 displays the detailed demographic characteristics of the respondents. Their age groups included 50 years and older (200 respondents; 38.10%), those of 30-49 years old (185 respondents; 35.99%), and younger than 30 years (129 respondents; 25.10%). The number of female respondents was 383 (74.51%); most were Buddhists (511; 99.41%) and all of them were Cambodian by nationality.

Table 3 shows respondents' motives for consuming *Elaeocarpus hygrophilus Kurz* based on sensory characteristics and product type awareness. A total of 449 consumers (87.35%) preferred the taste of *Elaeocarpus hygrophilus Kurz* products.

Table 4 shows the consumption habits of *Elaeocarpus hygrophilus Kurz* products. A total of six available products were identified in this study, including pickled, smashed-in-sugar, fresh, caramelized, pickled-in-honey, and pickled-in-rice liquor. Among all the products, the former four products were consumed the most. The number of consumers who bought pickled *Elaeocarpus hygrophilus Kurz* from markets was 415 (80.73%), whereas only 26 respondents (5.05%) made it themselves. The smashed-in-sugar products were bought by 355 respondents (69.06%). A total of 238 respondents (46.30%) tended to consume store-bought pickled *Elaeocarpus hygrophilus Kurz* and 215 respondents (41.82%) bought smashed-in-sugar products. As consumers today may not have enough time to make these products by themselves, purchasing and eating both products out-of-home were likely more desired. According to Mihalopoulos and Demoussis (2001), consumers facing time

constraints mostly opt for eating out, rather than home cooking. During the Pchum Ben festival, 220 (42.80%), 123 (23.93%), and 73 respondents (14.20%) reported eating the pickled, smashed-in-sugar, and fresh varieties, respectively, while during the Khmer New Year, wedding ceremonies, and the water festival, 52 (10.11%), 31 (6.03%), and 54 respondents (10.50%), respectively, consumed these products. The pickled, smashed-in-sugar, and fresh products were commonly consumed as a snack during break times at work or during Cambodian festivities, suggesting that a high frequency of snack consumption is based on occasional festivities, location, and food availability (Mackenbach et al., 2022).

Table 5 shows the consumption frequency of these products, indicating three, based on consumer preference, including the pickled variety (12 respondents; 2.33%), smashed-in-sugar variety (13 respondents; 2.52%), and the fresh fruit (four respondents; 0.77%), which they consume every day among other products. These findings indicate that the high consumption frequency of *Elaeocarpus hygrophilus* Kurz products is relatively related to people's tastes. Therefore, taste is the primary driver of food preference, and it is the most important factor influencing food choices based on individual judgment (Chan and Zhang, 2022).

**Table 2 Demographics of respondents**

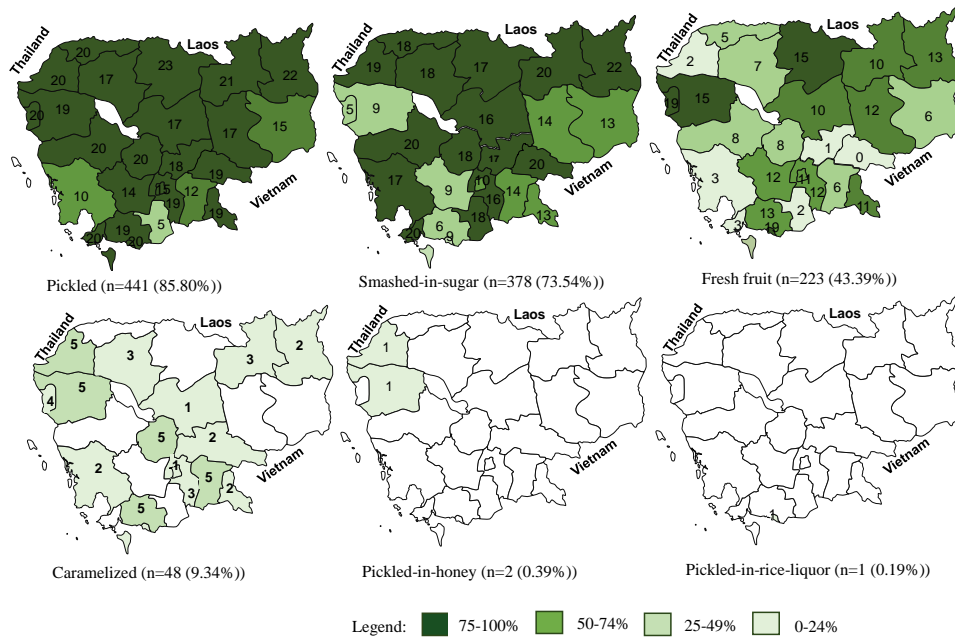
Classification	Description	Frequency (%)	
Age group	≤29	129	(25.10)
	30-49	185	(35.99)
	≥50	200	(38.10)
Gender	Male	131	(25.48)
	Female	383	(74.51)
Religion	Buddhist	511	(99.41)
	Muslim	1	(0.19)
	Christian	2	(0.38)
Nationality	Cambodian	514	(100.00)

**Table 3 Motives in *Elaeocarpus hygrophilus* Kurz**

Classification	Frequency (%)	
Sensory characteristic		
Taste	449	(87.35)
Smell	37	(7.19)
Color	24	(4.66)
Appearance	150	(29.18)
Health benefit	21	(4.08)
Product type awareness		
Pickled	485	(94.40)
Smashed-in-sugar	337	(65.60)
Fresh	152	(29.60)
Caramelized	70	(13.60)
Pickled-in-honey	1	(0.02)
Pickled-in-rice-liquor	3	(0.60)

Figure 2 illustrates the consumption trends of *Elaeocarpus hygrophilus* Kurz products by province. Regarding the relationship between consumption trends and geographical areas, we found six products available in Cambodia. The pickled product showed the highest number and ratio in all provinces of Cambodia, being chosen by 441 respondents (85.80%), implying that it was 75%–100% available for consumption in all provinces. The fresh fruit was moderately consumed, based on a 0%–24% to 75%–100% availability. Hence, three products – pickled, smashed-in-sugar, and fresh fruit – might be consumed more based on their availability, especially in markets, in all Cambodian provinces. While the caramelized product might also be available, only 48 respondents (9.34%) consumed it, demonstrating less interest in the product. The other two products – pickled-in-honey and pickled-in-rice liquor – showed less consumption in each province, implying that they were less

commercial and more homemade products that some prepared when having spare time. Therefore, four available products – pickled, smashed-in-sugar, fresh, and caramelized – were used for analysis.



**Fig. 2 Consumption trends of *Elaeocarpus hygrophilus* Kurz in all Cambodian provinces**

**Table 4 Consumption habits related to *Elaeocarpus hygrophilus* Kurz products**

	Pickled (%)		Smashed-in-sugar (%)		Fresh (%)		Caramelized (%)		Pickled-in-honey (%)		Pickled-in-rice liquor (%)	
<b>Product types</b>												
Buy	415	(80.73)	355	(69.06)	208	(40.46)	43	(8.36)	0	(0.00)	0	(0.00)
Own processing	26	(5.05)	21	(4.08)	16	(3.11)	5	(0.97)	2	(0.38)	1	(0.19)
<b>Eating location</b>												
At home	202	(39.30)	160	(31.12)	129	(25.09)	17	(3.30)	2	(0.38)	1	(0.19)
Outside	238	(46.30)	215	(41.82)	92	(17.89)	27	(5.25)	0	(0.38)	0	(0.00)
<b>Occasions</b>												
Pchum Ben	220	(42.80)	123	(23.93)	73	(14.20)	29	(5.64)	0	(0.00)	0	(0.00)
Khmer new year	52	(10.11)	4	(3.51)	19	(3.69)	19	(3.69)	0	(0.00)	0	(0.00)
Wedding	31	(6.03)	19	(3.69)	9	(1.75)	9	(1.75)	0	(0.00)	0	(0.00)
Water festival	54	(10.50)	56	(10.89)	23	(4.47)	5	(0.97)	0	(0.00)	0	(0.00)
Recreation	213	(41.43)	121	(23.52)	92	(17.89)	40	(7.78)	0	(0.00)	0	(0.00)

Table 6 shows the results of the ordered probit model on consumers’ habits and demographic characteristics. The chi-squared statistics from the models were statically significant ( $P < 0.00$ ;  $\chi^2(18) = 184.70, 155.02, 388.04, \text{ and } 105.81$ ,  $Pro > \text{chi-square} = 0.00$ ) for each product, suggesting that the models have a good fit (Oyetunde-Usman et al., 2021). We found that four group ages (Age 1–Age 4) were positively significant at 1% and 10% with the pickled and smashed-in-sugar products of *Elaeocarpus hygrophilus* Kurz, respectively. Although the fresh fruit was not statistically significant, it showed a positive sign. Therefore, these age groups were more likely to eat more pickled, smashed-in-sugar, and fresh fruit. However, the coefficient was negative for the Age 4 and Age 5 groups with the caramelized product. Furthermore, consumers older than 49 years were less

likely to eat the caramelized product, which may be determined by health problems. Interestingly, production type was positively and significantly correlated with the caramelized, pickled, and smashed-in-sugar variants at 1%, 5%, and 10%, respectively, meaning that consumers who considered making these products at home were more likely to eat them than those who purchased. This shows that home producers seemed to be overly concerned about food safety if they purchased these products from local wet markets, as they have no expiry date and labeling.

**Table 5 Consumption frequency of *Elaeocarpus hygrophilus* Kurz products**

Consumption frequency	Pickled (%)		Smashed-in-sugar (%)		Fresh (%)		Caramelized (%)		Pickled-in-honey (%)		Pickled-in-rice liquor (%)	
Never	73	(14.20)	138	(26.84)	291	(56.61)	465	(90.66)	512	(99.61)	513	(99.81)
1-2 times per year	66	(12.84)	52	(10.11)	51	(9.92)	30	(5.83)	2	(0.38)	1	(0.18)
1 time per three months	126	(24.51)	86	(16.73)	70	(13.61)	9	(1.75)	0	(0.00)	0	(0.00)
1 time per month	140	(27.23)	107	(20.81)	66	(12.84)	6	(1.16)	0	(0.00)	0	(0.00)
1 time per week	64	(12.45)	79	(15.37)	23	(4.47)	0	(0.00)	0	(0.00)	0	(0.00)
2-3 times per week	33	(6.42)	39	(7.58)	9	(1.75)	2	(0.38)	0	(0.00)	0	(0.00)
Every day	12	(2.33)	13	(2.52)	4	(0.77)	1	(0.19)	0	(0.00)	0	(0.00)
Total samples	514	100	514	100	514	100	514	100	514	100	514	100

Eating location was shown in a positively significant correlation at 1% with all four product types. Consumers tended to eat these products at home rather than outside. Regarding occasions, Pchum Ben, the water festival, and recreation were positively and significantly correlated at 1%, 5%, and 10% with the fresh fruit, smashed-in-sugar, and pickled products, respectively. Furthermore, consumers who considered these events important were more likely to consume the products. In addition, the taste and appearance of the fresh and pickled fruit were positively and significantly correlated at 1% and 10%, respectively, implying that consumers who perceived them important tended to have more on both fresh and pickled fruit compared to those who did not. However, consumers were less likely to eat the caramelized item for reasons such as unwanted sweetness and food abstention. Thus, the pickled and fresh fruit seemed to gain more interest from consumers because of health benefit reasons.

In the post-estimation of the ordered probit model, the marginal effect results of the pickled, smashed-in-sugar, fresh, and caramelized products are shown in Tables 7–10, respectively. In this part of the study, the overall probabilities of low, medium, and high consumption were estimated for all products of *Elaeocarpus hygrophilus* Kurz. We found that age groups were significantly associated with all levels of consumption frequency of the pickled product (Tables 7–10, Fig. 3), with the probability of low consumption decreasing by age group (Age 1 = 12.00%, Age 2 = 10.00%, Age 3 = 8.00%, Age 4 = 9.00%, Age 5 = 1.00% less likely of a low consumption). Regarding the smashed-in-sugar product (Fig. 3), age groups were significantly associated with consumption frequency, meaning that the average consumption increased by age group (Age 1 = 7.00%, Age 2 = 10.00%, Age 3 = 9.00%, Age 4 = 9.00%, Age 5 = 6.00%). These results indicate that younger people are more likely to eat pickled and smashed-in-sugar products than the older population. The latter may deal with health problems in terms of chronic diseases, such as high blood pressure or food allergies, resulting in fermented food abstention. Health conditions and dietary requirements are the main factors leading to changes in food consumption habits in older generations (O'Mahony et al., 2023).

In Table 9 and Fig. 3, Age 1 and Age 4 were positively and significantly associated with fresh fruit consumption frequency, showing that consumers older than 19 were 2.00% more likely to have a low consumption of fresh fruit than those younger than 19 years. Interestingly, the Age 1 group were 17.00% more likely to have an average consumption of fresh fruit. Consumers in the Age 4 group (over 49 years) were 3.00% more likely to have low consumption of fresh fruit, surprisingly, being 13.00% more likely to reach the average consumption. Although other age groups were not

significantly correlated with the fresh fruit, positive trends were observed. Older adults were more likely to eat the fresh fruit of *Elaeocarpus hygrophilus* Kurz. Younger ages habitually prefer to consume young fresh fruits, for example, young mango or wooden apple. This habit may not change when they become older, because of their adopted food experience and taste preferences from their childhood (Brady et al., 2022).

**Table 6 Ordered probit including consumer habits and demographic characteristics**

Variables	Pickled		Smashed-in-sugar		Fresh fruit		Caramelized	
	Coef.	Std. Err	Coef.	Std. Err	Coef.	Std. Err	Coef.	Std. Err
Age 1	1.12***	(0.23)	0.47*	(0.22)	0.50	(0.27)	0.25	(0.38)
Age 2	0.77***	(0.17)	0.62***	(0.16)	0.16	(0.19)	0.33	(0.27)
Age 3	0.62***	(0.17)	0.50***	(0.15)	0.03	(0.19)	0.19	(0.25)
Age 4	0.67***	(0.17)	0.57***	(0.16)	0.42*	(0.19)	-0.01	(0.30)
Age 5	0.03	(0.19)	0.33	(0.19)	0.02	(0.23)	-0.12	(0.34)
Gender	0.10	(0.13)	-0.12	(0.12)	-0.13	(0.15)	0.14	(0.20)
Production type	0.70**	(0.25)	0.53*	(0.26)	0.30	(0.31)	2.66***	(0.63)
Eating location	0.62***	(0.12)	0.84***	(0.12)	1.60***	(0.14)	2.64***	(0.34)
Pchum Ben	0.55***	(0.12)	0.35*	(0.14)	1.06***	(0.17)	-0.65	(0.54)
Khmer new year	-0.01	(0.09)	0.10	(0.15)	0.24	(0.15)	-0.11	(0.32)
Wedding	0.22	(0.09)	0.04	(0.98)	0.13	(0.15)	-1.52	(87.70)
Water festival	0.15**	(0.05)	0.11*	(0.05)	0.21***	(0.07)	-0.84	(81.22)
Recreation	0.09***	(0.02)	0.12***	(0.28)	0.23***	(0.03)	0.08	(0.07)
Taste	0.34	(0.18)	0.31	(0.17)	0.49*	(0.22)	0.11	(0.29)
Smell	-0.25	(0.25)	0.23	(0.24)	-1.29***	(0.38)	-0.48	(0.37)
Color	0.38	(0.28)	0.03	(0.26)	-0.11	(0.34)	0.65	(0.34)
Appearance	0.28*	(0.14)	-0.15	(0.14)	0.63***	(0.16)	0.32	(0.22)
Good health	0.45	(0.29)	-0.09	(0.27)	0.90**	(0.29)	-3.36***	(1.03)
Cut points								
cut 1	0.31***		0.40***		1.69***		1.91***	
cut 2	0.95***		0.78***		2.24***		2.71***	
cut 3	3.38***		2.68***		4.66***		3.74***	
Log-likelihood	441.43		-515.32		-323.72		-146.46	
LR chi <sup>2</sup> (18)	184.70		155.02		388.04		105.81	
Prob > chi <sup>2</sup>	0.00		0.00		0.00		0.00	
Pseudo R <sup>2</sup>	0.17		0.13		0.37		0.27	

Remarks: \*, \*\*, and \*\*\* indicate that the coefficient is statistically significant at the 10%, 5%, and 1% levels, respectively.

However, in Table 10 and Fig. 3, Age 4 was negatively and significantly correlated with the consumption frequency of the caramelized product of *Elaeocarpus hygrophilus* Kurz; Age 5 showed a similar negative trend but was not statistically significant. Results showed that older adults (in both age groups) were 1.00% less likely to have low consumption. The sweet taste of the caramelized product determines adults over 49 years to consume it less, especially if they are faced with serious health consequences (e.g., diabetes), which usually result in diet restrictions on the consumption of confectionary and sugary products (Cheah et al., 2023).

Our findings showed that production type was significantly correlated with all levels of consumption frequency of the pickled and smashed-in-sugar *Elaeocarpus hygrophilus* Kurz, meaning that consumers who made these products at home were 9.00% and 4.00%, respectively, less likely to manifest low consumption of both products than those who purchased the products (Tables 7 and 8). However, the home producers were 11.00% (pickled) and 7.00% (smashed-in-sugar) more likely to have high and medium consumption of these products than purchasers. Consequently, although the number of product purchasers was higher than that of home producers (for all products), the latter may show higher consumption because they make these products in large amounts, enjoying them with their families or friends. In contrast, while the number of purchasers is higher than that of home producers (Table 4), they seem to consume a smaller amount, as a small amount of money



needs to be paid. Moreover, in Cambodia, those who make and consume their homemade products may care more about food safety issues, as the products sold in local wet markets lack labels, and expiry dates, are freely open-cover, and may contain unknown food additives, presenting health risks through food-borne diseases. Purchasing unhealthy foods may cause serious health problems due to microbial and chemical hazards (Ishra et al., 2022).

The eating location was shown to have the same trends as the production type. It was significantly associated with all levels of consumption frequency of pickled, smashed-in-sugar, and fresh fruit.

This means that consumers who preferred eating at home in the pickled and the smashed-in-sugar products increased the probabilities 8.00% and 6.00% each from low consumption to 10.00% and 14.00%, respectively, of moderate consumption compared to those who preferred eating out. Surprisingly, consumers who ate the fresh fruit at home were 52.00% more likely to achieve the average consumption than those eating out. Those who preferred eating the pickled, smashed-in-sugar, and fresh fruit at home tended to exhibit a positive emotional experience regarding food safety than those who did not; hence, their preference for processing these products by themselves at home, and freely enjoying their consumption. This result is similar to Lu et al.'s (2011) study, which concluded that consumers' positive emotional experiences in eating meals at home in North America were due to engaging in healthier meal choices because of ensuring food safety and long-term health benefits.

**Table 7 Marginal effects of consumption frequency on the pickled product**

Variables	Consumption frequency of the pickled product							
	Never		Low		Medium		High	
	Coef.	Std. Err	Coef.	Std. Err	Coef.	Std. Err	Coef.	Std. Err
Age 1	-0.08***	(0.01)	-0.12***	(0.02)	-0.01	(0.05)	0.22**	(0.07)
Age 2	-0.08***	(0.02)	-0.10***	(0.02)	0.07***	(0.01)	0.11***	(0.04)
Age 3	-0.07***	(0.02)	-0.08***	(0.02)	0.07***	(0.01)	0.08**	(0.03)
Age 4	-0.07***	(0.02)	-0.09***	(0.02)	0.06***	(0.02)	0.09**	(0.03)
Age 5	-0.01	(0.03)	-0.01	(0.03)	0.01	(0.04)	0.01	(0.02)
Gender	-0.01	(0.02)	-0.01	(0.02)	0.02	(0.02)	0.01	(0.01)
Production type	-0.06***	(0.02)	-0.09***	(0.03)	0.04	(0.03)	0.11*	(0.06)
Eating location	-0.08***	(0.02)	-0.08***	(0.02)	0.10***	(0.02)	0.06***	(0.02)
Pchum Ben	-0.08***	(0.01)	-0.07***	(0.02)	0.10***	(0.02)	0.05***	(0.02)
Khmer new year	0.01	(0.01)	0.01	(0.01)	-0.01	(0.02)	-0.01	(0.01)
Wedding	-0.03	(0.01)	-0.03	(0.01)	0.04	(0.02)	0.02	(0.09)
Water festival	-0.02**	(0.01)	-0.02**	(0.01)	0.03**	(0.01)	0.01**	(0.01)
Recreation	-0.01***	(0.04)	-0.01***	(0.00)	0.01***	(0.01)	0.01***	(0.00)
Taste	-0.06	(0.04)	-0.05	(0.03)	0.08	(0.05)	0.02*	(0.01)
Smell	0.04	(0.05)	0.03	(0.04)	-0.06	(0.07)	-0.02	(0.02)
Color	-0.04	(0.03)	-0.05	(0.04)	0.04**	(0.02)	0.05	(0.05)
Appearance	-0.04*	(0.02)	-0.04*	(0.02)	0.05	(0.02)	0.03	(0.02)
Good health	-0.05*	(0.02)	-0.06	(0.04)	0.05***	(0.01)	0.06	(0.05)

Remarks: \*, \*\*, and \*\*\* indicate that the coefficient is statistically significant at the 10%, 5%, and 1% levels, respectively. "0" represents the lowest frequency (never); "1" represents low (once every three months or one to two times a year); "2" represents medium (once a week or once a month); "3" represents high (every day or one to two times per week); variable inflation factor (VIF) < 1.48.

Regarding occasions, we found that Pchum Ben, the water festival, and recreation were significantly associated with pickled, smashed-in-sugar, and fresh fruit. Consumers who regarded Pchum Ben as important were 7.00% and 2.00% less likely to register a low consumption of pickled and smashed-in-sugar fruit, respectively, than those who did not. This may be because some Cambodian people changed their habitual food consumption by adopting quality and safety standards for their foods, leading to lower consumption of unstandardized local foods. Moreover, the new lifestyle and better-off income of local consumers stimulate them to change their habitual consumption. For instance, consumers with a high income living in South Korea prefer to consume organic foods because of an enhanced quality of life (Han and Lee, 2022). Furthermore, the pickled

and smashed-in-sugar products were respectively 10.00% and 7.00% more likely to reach the medium level of consumption than others. Pchum Ben showed the highest probability (37%) of consumers reaching medium consumption of the fresh fruit product, followed by the water festival and recreation (Table 8). This implies that those with low income are less concerned about food safety compared to those with better-off income; therefore, they may purchase any available or cheaper food, regardless of its poorer quality or safety. In particular, when celebrating occasions in Cambodia, consumers gather with their families and enjoy these products as snack foods. Similarly, during the Chinese New Year, the Chinese food known as *Chap Chye* is consumed in large quantities due to family reunions for dinner (Chien and Karim, 2016).

Our findings showed that gender was not significantly correlated with any level of consumption frequency of the pickled, smashed-in-sugar, fresh, and caramelized products of *Elaeocarpus hygrophilus* Kurz; however, the coefficient showed positive and negative trends (Tables 7–10). Males were 2.00% and 1.00% more likely to have a moderate consumption of the pickled and caramelized products, respectively, and 1.00% more likely to have a high consumption of both, compared to females (Tables 6 and 9). However, they were 3.00% less likely to have a moderate consumption of the smashed-in-sugar and fresh fruits, and 1.00% less likely to have a high consumption of these products compared to females. The taste of smashed-in-sugar and fresh fruit of *Elaeocarpus hygrophilus* Kurz is a little sour and bitter, which makes them more appreciated by women as they are usually consumed with dried or fresh spicy chili, which are considered the favorite foods of Cambodian women (Yang et al., 2018). Moreover, in Cambodian culture and tradition, women have an active role in food preparation and are more likely to know about fermented foods than men; therefore, they may feel more interested in food consumption than men (Ganiyusufoglu et al., 2022).

**Table 8 Marginal effects of consumption frequency on the smashed-in-sugar product**

Variables	Consumption frequency of the smashed-in-sugar product							
	Never		Low		Medium		High	
	Coef.	Std. Err	Coef.	Std. Err	Coef.	Std. Err	Coef.	Std. Err
Age 1	-0.11**	(0.05)	-0.03	(0.02)	0.07***	(0.02)	0.08	(0.05)
Age 2	-0.15***	(0.03)	-0.05***	(0.02)	0.10***	(0.02)	0.10**	(0.03)
Age 3	-0.13***	(0.04)	-0.03**	(0.01)	0.09***	(0.02)	0.07*	(0.03)
Age 4	-0.14***	(0.03)	-0.04**	(0.02)	0.09***	(0.02)	0.09*	(0.04)
Age 5	-0.08	(0.05)	-0.02	(0.02)	0.06	(0.03)	0.05	(0.04)
Gender	0.03	(0.04)	0.01	(0.01)	-0.03	(0.03)	-0.01	(0.01)
Production type	-0.12**	(0.05)	-0.04	(0.02)	0.07***	(0.02)	0.09	(0.06)
Eating location	-0.21***	(0.03)	-0.06***	(0.01)	0.14***	(0.02)	0.13***	(0.03)
Pchum Ben	-0.09**	(0.04)	-0.02*	(0.01)	0.07**	(0.02)	0.05*	(0.02)
Khmer new year	-0.03	(0.04)	-0.01	(0.01)	0.02	(0.04)	0.01	(0.02)
Wedding	-0.01	(0.03)	-0.01	(0.01)	0.09	(0.02)	0.01	(0.01)
Water festival	-0.03	(0.01)	-0.01*	(0.00)	0.02*	(0.01)	0.01*	(0.01)
Recreation	-0.03***	(0.01)	-0.01***	(0.00)	0.03***	(0.01)	0.02***	(0.00)
Taste	-0.10	(0.06)	-0.01	(0.01)	0.08	(0.05)	0.03*	(0.02)
Smell	-0.06	(0.06)	-0.01	(0.02)	0.04	(0.04)	0.03	(0.04)
Color	-0.01	(0.08)	-0.01	(0.02)	0.01	(0.06)	0.01	(0.03)
Appearance	0.04	(0.04)	0.01	(0.01)	-0.04	(0.04)	-0.02	(0.02)
Good health	0.02	(0.09)	0.01	(0.02)	-0.02	(0.07)	-0.01	(0.03)

Remarks: \*, \*\*, and \*\*\* indicate that the coefficient is statistically significant at the 10%, 5%, and 1% levels, respectively. "0" represents the lowest frequency (never); "1" represents low (once every three months or one to two times a year); "2" represents medium (once a week or once a month); "3" represents high (every day or one to two times per week); variable inflation factor (VIF) < 1.53.

Food color showed a significant correlation with the consumption frequency of the pickled product, suggesting that consumers who perceived its color as important were 4.00% more likely to reach medium consumption than others (Table 7). Taste and appearance (Table 9) showed a significant correlation with the consumption frequency of fresh fruit: consumers who considered the taste and appearance of the product as important were 5.00% and 4.00%, respectively, more likely to have a low consumption of this product. Additionally, those who perceived the taste and appearance of the fresh fruit as important were 12.00% and 20.00%, respectively, more likely to have a medium consumption of it. Perhaps, Cambodian people tend to prefer the pickled and fresh fruit of

*Elaeocarpus hygrophilus* Kurz because they seem interested in the fresh color, adoptable taste, and good appearance of the products. A relevant study found that consumers in the Netherlands preferred consuming carrots with an attractive color suggestive of freshness and naturalness (Schifferstein et al., 2019). Furthermore, eating fresh fruits is simply a habit for some Cambodians, as they have done this since childhood. High consumption of specific foods is closely related to taste pleasantness and food familiarity (Gumussoy and Rogers, 2023).

Among sensory attributes, the smell was negatively significant in all levels of consumption frequency of the fresh fruit of *Elaeocarpus hygrophilus* Kurz, meaning that 15.00% of the consumers who considered the smell of fresh fruit important were less likely to have low consumption, and 23.00% were less likely to reach the medium consumption of this product compared to those who did not. Perhaps, consumers who do not consider the smell of fresh fruit important intend to eat more of it as their focus may be on its taste and appearance, which is similar to the case of mandarins, as their taste and appearance are the main drivers of fruit preference and acceptance by eaters (Gámbaro et al., 2021). Additionally, whether young or mature, this fruit does not have a strong smell, resulting in a low focus on this aspect. In our study, older age groups (Table 9) are likely to consume less fresh fruit because of unwanted tastes, health issues, and strong smell recognition ability, leading them to have less interest in its consumption than the younger generations. As shown in prior studies, people of older ages have a stronger ability to recognize smell than younger people due to different brain functioning, thereby choosing high-quality food for consumption (Honnens et al., 2023).

**Table 9 Marginal effects of consumption frequency on the fresh fruit product**

Variables	Consumption frequency of the fresh fruit product							
	Never		Low		Medium		High	
	Coef.	Std. Err	Coef.	Std. Err	Coef.	Std. Err	Coef.	Std. Err
Age 1	-0.19	(0.11)	0.02	*** (0.01)	0.17	(0.10)	0.01	(0.00)
Age 2	-0.06	(0.08)	0.01	(0.01)	0.05	(0.06)	0.01	(0.00)
Age 3	-0.02	(0.07)	0.01	(0.02)	0.01	(0.06)	0.01	(0.00)
Age 4	-0.17	(0.07)	0.03	** (0.01)	0.13	* (0.07)	0.01	(0.00)
Age 5	-0.01	(0.01)	0.01	(0.02)	0.01	(0.07)	0.01	(0.00)
Gender	0.05	(0.06)	-0.01	(0.01)	-0.03	(0.04)	-0.01	(0.00)
Production type	-0.12	(0.12)	0.02	(0.01)	0.10	(0.11)	0.01	(0.00)
Eating location	-0.57	*** (0.04)	0.02	(0.02)	0.52	*** (0.04)	0.02	* (0.01)
Pchum Ben	-0.39	*** (0.05)	0.02	(0.02)	0.37	*** (0.06)	0.01	* (0.01)
Khmer new year	-0.09	(0.06)	0.02	(0.01)	0.07	(0.05)	0.01	(0.00)
Wedding	-0.05	(0.06)	0.01	(0.01)	0.04	(0.04)	0.01	(0.00)
Water festival	-0.09	** (0.03)	0.02	** (0.01)	0.06	*** (0.02)	0.01	(0.00)
Recreation	-0.09	*** (0.01)	0.02	*** (0.00)	0.07	*** (0.01)	0.01	(0.00)
Taste	-0.18	* (0.07)	0.05	(0.03)	0.12	** (0.05)	0.01	* (0.00)
Smell	0.37	*** (0.06)	-0.15	*** (0.04)	-0.23	*** (0.32)	-0.01	(0.00)
Color	0.04	(0.01)	-0.01	(0.04)	-0.03	(0.09)	-0.01	(0.00)
Appearance	-0.25	*** (0.10)	0.04	*** (0.01)	0.20	*** (0.06)	0.01	* (0.00)
Good health	-0.33	*** (0.09)	0.01	(0.02)	0.31	** (0.11)	0.01	(0.01)

Remarks: \*, \*\*, and \*\*\* indicate that the coefficient is statistically significant at the 10%, 5%, and 1% levels, respectively; "0" represents the lowest frequency (never); "1" represents low (once every three months or one to two times a year); "2" represents medium (once a week or once a month); "3" represents high (every day or one to two times per week; variable inflation factor (VIF) < 1.41.

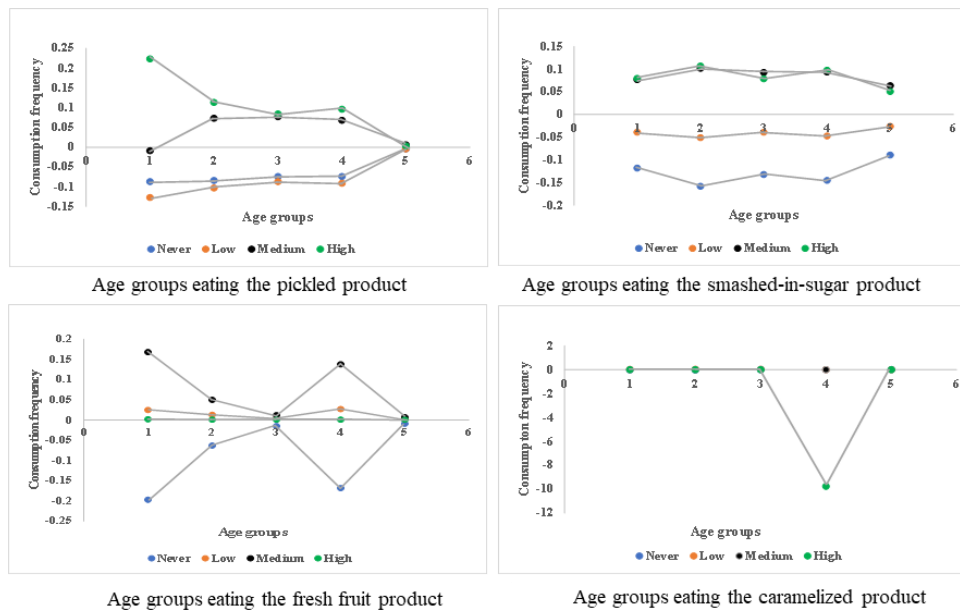
Interestingly, we found that good health benefits were positively significant in the consumption frequency of the pickled (Table 7) and fresh fruit (Table 9) of *Elaeocarpus hygrophilus* Kurz. Consumers who perceived pickled products as having health benefits were 5.00% more likely to reach medium consumption, and surprisingly, 31.00% more likely to reach the medium consumption of fresh fruit compared to those who did not. It seems that in Cambodia, some of the local people take into account that the *Elaeocarpus hygrophilus* Kurz plant is used as a traditional remedy for curing some ailments, including fever, and flu, or improving women's blood circulation after giving birth. Moreover, it enriches the essential vitamin intake. Therefore, consuming this fruit relates to self-care and health awareness. The awareness of the health benefits of foods stimulates consumers

to pay increasing attention to their food consumption (Yang et al., 2023). Moreover, in Cambodia, fresh fruit consumption depends on people’s attitudes and regional location; for example, consumers may adopt their friend's and relatives’ consumption patterns of eating pickled and fresh fruits for pleasantness. The social environment and influence of other people have a direct impact on food choices (Pluck and Morrison-Saunders, 2022).

**Table 10 Marginal effects of consumption frequency on the caramelized product**

Variables	Consumption frequency of the caramelized product							
	Never		Low		Medium		High	
	Coef.	Std. Err	Coef.	Std. Err	Coef.	Std. Err	Coef.	Std. Err
Age 1	-0.02	(0.25)	0.02	(0.18)	0.01	(0.07)	0.01	(0.01)
Age 2	-0.03	(0.32)	0.02	(0.23)	0.01	(0.10)	0.01	(0.01)
Age 3	-0.01	(0.17)	0.01	(0.13)	0.03	(0.05)	0.01	(0.00)
Age 4	0.01*	(0.03)	-0.01*	(0.02)	-0.01	(0.01)	-9.77	(0.00)
Age 5	0.01	(0.10)	-0.01	(0.08)	-0.01	(0.02)	-0.01	(0.00)
Gender	-0.01	(0.13)	0.01	(0.10)	0.01	(0.03)	0.01	(0.00)
Production type	-0.77	(1.01)	0.24	(1.14)	0.35	(0.69)	0.17	(1.46)
Eating location	-0.76	(1.15)	0.25	(1.01)	0.34	(0.81)	0.15	(1.35)
Pchum Ben	0.04	(0.39)	-0.03	(0.30)	-0.01	(0.08)	-0.01	(0.00)
Khmer new year	0.01	(0.11)	-0.01	(0.08)	-0.01	(0.03)	-0.01	(0.00)
Wedding	0.13*	(6.77)	-0.11*	(5.65)	-0.02	(1.09)	-0.01	(0.05)
Water festival	0.07*	(6.87)	-0.06*	(5.66)	-0.01	(1.16)	-0.01	(0.05)
Recreation	-0.01	(0.07)	0.01	(0.06)	0.01	(0.02)	0.01	(0.00)
Taste	-0.01	(0.10)	0.01	(0.07)	0.01	(0.02)	0.01	(0.00)
Smell	0.03	(0.32)	-0.02	(0.25)	-0.01	(0.07)	-0.01	(0.00)
Color	-0.09	(0.73)	0.07	(0.46)	0.02	(0.25)	0.01	(0.03)
Appearance	-0.03	(0.30)	0.02	(0.22)	0.01	(0.08)	0.01	(0.01)
Good health	0.05	(0.63)	-0.04*	(0.50)	-0.01	(0.12)	-0.01	(0.01)

Remarks: \*, \*\*, and \*\*\* indicate that the coefficient is statistically significant at the 10%, 5%, and 1% levels, respectively; “0” represents the lowest frequency (never), “1” represents low (once every three months or one to two times a year), “2” represents medium (once a week or once a month); “3” represents high (every day or one to two times per week; variable inflation factor (VIF) < 1.81.



**Fig. 3 Marginal effects of age groups and consumption of *Elaeocarpus hygrophilus* Kurz**

**CONCLUSION**

This study analyzed six products of the *Elaeocarpus hygrophilus* Kurz fruit that are found in Cambodia, including pickled, smashed-in-sugar, fresh, caramelized, pickled-in-honey, and pickled-in-rice liquor products. The pickled, smashed-in-sugar, fresh, and caramelized *Elaeocarpus hygrophilus* Kurz products were found more likely to be consumed. Most consumers purchase them from markets rather than processing them at home, and they tend to eat more of the pickled, smashed-in-sugar, and fresh fruits. Younger people tended to have a medium consumption of pickled, smashed-in-sugar, and fresh fruits, while older generations tended to eat less caramelized products because of their unwanted sweet taste and health risks. Men tended to have a medium consumption of pickled and caramelized products compared to women because they preferred the sweet taste preference; however, women tended to have a medium consumption of smashed-in-sugar and fresh fruits due to their preferences for acidic, bitter, and spicy foods. The consumers who prepared pickled and smashed-in-sugar products at home showed a medium consumption of both products. Home-food eaters showed a similar trend. Regarding occasions, those who considered Pchum Ben important tended to have a medium consumption of pickled, smashed-in-sugar, and fresh fruits. Consumers perceiving taste and appearance as important tended to show a medium consumption of fresh fruit. All products widely sold at local markets lack expiry dates, proper packaging, and labeling. Therefore, future research should focus on consumer knowledge, behavior, and existing issues on consumption to find the challenges in developing effective strategies to improve such products. The basic nutritional facts and bioactive compounds of the *Elaeocarpus hygrophilus* Kurz products have not yet been identified, which could explain the difficulty in improving labeling for homemade food processors. Hence, nutritional evaluation and physiochemical properties, especially for fresh fruit should be identified as they serve for functional ingredient information, traditional product labeling enhancement, and consumer health promotion.

#### Note

1) Authors attempted to identify the species because neighboring countries such as Vietnam and Thailand use different scientific names for similar products with almost the same color, shape, and way of eating. The unknown plant specimens were investigated by using archived herbarium specimens ( Belhumeur et al., 2008 and Yadav et al., 2013). The fresh plant specimens such as leaves, flowers, fruits, and branches were collected from Svay Rieng province, Cambodia, in September 2023. They were dried in micro-oven for 48 hours with 80 °C; however, the fruits were dried for 72 hours with the same temperature set to remove water inside. Then the dried specimens were taken photographs and packed into folders with the right labels. After that, a common approach was used in plant species identification; meanwhile, unknown dried segments of plant were checked their shapes with the known species in herbarium specimens that were kept and preserved in long time. Both were shown in the same characteristics in shapes of leaves, flowers, or fruits; thereby, verifying in genuine species as *Elaeocarpus hygrophilus* Kurz.

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#### REFERENCES

- Belhumeur, P.N., Chen, D., Feiner, S., Jacobs, D.W., Kress, W.J., Ling, H., Lopez, I., Ramamoorthi, R., Sheorey, S., White, S., and Zhang, L. 2008. Searching the world's Herbaria: A system for visual identification of plant species. Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), 5305 LNCS (PART 4), 116-129, Retrieved from DOI <https://doi.org/10.1007/978-3-540-88693-8-9>
- Brady, P.J., Askelson, N.M., Thompson, H., Kersten, S., Hopkins, H., Ashida, S., Nothwehr, F., Janssen, B. and Frisvold, D. 2022. A qualitative study of factors influencing food choices and food sources among adults aged 50 years and older during the Coronavirus disease 2019 pandemic. Journal of the Academy of Nutrition and Dietetics, 123 (4), 602-613, Retrieved from DOI <https://doi.org/10.1016/j.jand.2022.08.131>
- Cantillo, J., Martín, J.C. and Román, C. 2021. Analysis of the main determinants of away-from-home

- consumption of fishery and aquaculture products in the EU28. *Appetite*, 163, Retrieved from DOI <https://doi.org/10.1016/j.appet.2021.105216>.
- Chan, E. and Zhang, L.S. 2022. Is this food healthy, the impact of lay beliefs and contextual cues on food healthiness perception and consumption. *Current opinion in Psychology*, 46, Retrieved from DOI <https://doi.org/10.1016/j.copsyc.2022.101348>.
- Cheah, Y.K., Pahlevan Sharif, S. and Abdul Adzis, A. 2023. Sociodemographic, lifestyle and insurance factors associated with household expenditure on sugary foods, a pooled cross-sectional analysis. *Human Nutrition and Metabolism*, 32, Retrieved from DOI <https://doi.org/10.1016/j.hnm.2023.200187>
- Chien, Y.N. and Karim, S.A. 2016. Historical and contemporary perspectives of the Nyonya food culture in Malaysia. *Journal of Ethnic Foods*, 3 (2), 93-106, Retrieved from DOI <https://doi.org/10.1016/j.jef.2016.05.004>.
- Chrun, R., Hosotani, Y., Kawasaki, S. and Inatsu, Y. 2017. Microbiological hazard contamination in fermented vegetables sold in local markets in Cambodia. *Biocontrol Science*, 22 (3), 181-185, Retrieved from DOI <https://doi.org/10.4265/bio.22.181>
- Deth, S. U., Bradley, J. M., Ou, V.R. and Michael, R.F. 2020. Culture and society. Christian Democratic Union of Germany, Germany, Retrieved from URL [www.futureforum.asia](http://www.futureforum.asia).
- Dy, P. 2000. Plants used in Cambodia. Dictionary of plants used in Cambodia, First ed. (January 2000), Imprimerie Olympic-Hor Thim, Phnom Penh, Cambodia.
- Gámbaro, A., Roascio, A., Hodos, N., Mígues, I., Lado, J., Heinzen, H. and Rivas, F. 2021. The impact of sensory attributes of mandarins on consumer perception and preferences. *Journal of Agriculture and Food Research*, 6, Retrieved from DOI <https://doi.org/10.1016/j.jafr.2021.100196>
- Ganiyusufoglu, E., Aytöp, Y., and Gezginc, Y. 2022. The determination of fermented food awareness and the effect of the Covid-19 pandemic period on fermented food consumption in Türkiye. *Progress in Nutrition*, 24 (4), Retrieved from DOI <https://doi.org/10.23751/pn.v24i4.13262>
- Gebre, G.G. and Rahut, D.B. 2021. Prevalence of household food insecurity in East Africa, Linking food access with climate vulnerability. *Climate Risk Management*, 33, Retrieved from DOI <https://doi.org/10.1016/j.crm.2021.100333>
- Giang, N.T.N. 2023. Optimization of ethanol and bioactive compounds fermentation of *Elaeocarpus hygrophilus Kurz* by using response surface methodology. *Food Research*, 7 (6), 128-134, Retrieved from DOI [https://doi.org/10.26656/fr.2017.7\(6\).040](https://doi.org/10.26656/fr.2017.7(6).040)
- Gumussoy, M. and Rogers, P.J. 2023. It tastes OK, but I don't want to eat it, New insights into food disgust. *Appetite*, 188, Retrieved from DOI <https://doi.org/10.1016/j.appet.2023.106642>
- Han, S. and Lee, Y. 2022. Analysis of the impacts of social class and lifestyle on consumption of organic foods in South Korea. *Heliyon*, 8 (10), Retrieved from DOI <https://doi.org/10.1016/j.heliyon.2022.e10998>.
- Honnens, E., Broge, D.L., Wendin, K., Rasmussen, M.A., Wender, L. and Bredie, P. 2023. Familiarity and identification of everyday food odors in older adults and their influence on hedonic liking. *Food Quality and Preference*, 103, Retrieved from DOI <https://doi.org/10.1016/j.foodqual.2022.104715>
- Ishra, R., Khanam, R. and Soar, J. 2022. Influence of food safety concerns on safe food purchasing at rural and urban consumers in Bangladesh. *Appetite*, 179, Retrieved from DOI <https://doi.org/10.1016/j.appet.2022.106306>
- Lanfranchi, M., Schimmenti, E., Campolo, M.G. and Giannetto, C. 2019. The willingness to pay of Sicilian consumers for a wine obtained with sustainable production method, An estimate through an ordered probit sample-selection model. *Wine Economics and Policy*, 8 (2), 203-215, Retrieved from DOI <https://doi.org/10.1016/j.wep.2019.11.001>
- LeGrand, K., Borarin, B. and Young, G.M. 2020. Tradition and fermentation science of *prohoc*, an ethnic fermented fish product of Cambodia. *Journal of Ethnic Foods*, 7 (1), 1-19, Retrieved from DOI <https://doi.org/10.1186/s42779-019-0027-1>
- Lu, J., Huet, C. and Dubé, L. 2011. Emotional reinforcement as a protective factor for healthy eating in home settings. *American Journal of Clinical Nutrition*, 94 (1), 254-261, Retrieved from DOI <https://doi.org/10.3945/ajcn.110.006361>
- Ly, D., Mayrhofer, S., Schmidt, J., Zitz, U. and Domig, K.J. 2020. Characteristics of Cambodian fermented foods. *Food*, 9, 1-19, Retrieved from DOI <https://doi.org/10.3390/foods9020198>.
- Kuria, M.W., Matofari, J.W. and Nduko, J.M. 2021. Physicochemical, antioxidant, and sensory properties of functional mango (*Mangifera indica* L.) leather fermented by lactic acid bacteria. *Journal of Agriculture and Food Research*, 6, 100206, Retrieved from DOI <https://doi.org/10.1016/j.jafr.2021.100206>
- Mackenbach, J.D., Hobbs, M. and Pinho, M.G. 2022. Where do Dutch adults obtain their snack foods, Cross-sectional exploration of individuals' interactions with the food environment. *Health and Place*, 75, Retrieved from DOI <https://doi.org/10.1016/j.healthplace.2022.102802>
- Mihalopoulos, V.G. and Demoussis, M.P. 2001. Greek household consumption of food away from home, A

- microeconomic approach. *European Review of Agricultural Economics*, 28 (4), 421-432, Retrieved from DOI <https://doi.org/10.1093/erae/28.4.421>
- O'Mahony, L., O'Shea, E., O'Connor, E.M., Tierney, A., Harkin, M., Harrington, J., Kennelly, S., Arendt, E., O'Toole, P.W. and Timmons, S. 2023. A qualitative study of older adults' and healthcare professionals' perspectives on the potential of functional food products to support healthy ageing. *Journal of Functional Foods*, 107, Retrieved from DOI <https://doi.org/10.1016/j.jff.2023.105689>
- Oyetunde-Usman, Z., Olagunju, K.O. and Ogunpaimo, O.R. 2021. Determinants of adoption of multiple sustainable agricultural practices among smallholder farmers in Nigeria. *International Soil and Water Conservation Research*, 9 (2), 241-248, Retrieved from DOI <https://doi.org/10.1016/j.iswcr.2020.10.007>
- Pluck, S. and Morrison-Saunders, A. 2022. Where we work determines what we eat, A qualitative exploration of the multi-dimensional influences on meat consumption when home and office working during the Covid-19 lockdown in London, UK. *Appetite*, 178, Retrieved from DOI <https://doi.org/10.1016/j.appet.2022.106147>
- Schifferstein, H.N.J., Wehrle, T. and Carbon, C.C. 2019. Consumer expectations for vegetables with typical and atypical colors, The case of carrots. *Food Quality and Preference*, 72, 98-108, Retrieved from DOI <https://doi.org/10.1016/j.foodqual.2018.10.002>
- Shrestha, N. 2020. Detecting multicollinearity in regression analysis. *American Journal of Applied Mathematics and Statistics*, 8(2), 39-42, Retrieved from DOI <https://doi.org/10.12691/ajams-8-2-1>
- Tully, J.A. 2005. A short history of Cambodia, From empire to survival. National Library of Australia, Crow's Nest NSW 2065. ISBN 1 74114 763 8
- Yadav, S. Y. 2013. Collection and preserving plant specimens, a manual. Department of Science, Information Technology and Innovation, August, 22, Brisbane QLD 4066, Australia.
- Yamamoto, S. and Matsumoto, T. 2011. Rice fermentation starters in Cambodia, Cultural importance and traditional methods of production. *Southeast Asian Studies*, 49 (2), 192-213.
- Yang, K., Li, Y., Mao, Z., Liu, X., Zhang, H., Liu, R., Xue, Y., Tu, R., Liu, X., Zhang, X., Li, W. and Wang, C. 2018. Relationship between spicy flavor, spicy food intake frequency, and general obesity in a rural adult Chinese population, The Rural Diab study. *Nutrition, Metabolism and Cardiovascular Diseases*, 28 (3), 252-261, Retrieved from DOI <https://doi.org/10.1016/j.numecd.2017.10.021>
- Yang, Q., Al Mamun, A., Naznen, F., Siyu, L. and Makhbul, Z.K.M. 2023. Modeling the significance of health values, beliefs, and norms on the intention to consume and the consumption of organic foods. *Heliyon*, 9 (6), Retrieved from DOI <https://doi.org/10.1016/j.heliyon.2023.e17487>