

Knowledge, attitudes and practices toward mushrooms as food and food supplements among Klang Valley, Malaysia residents

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Abstract

Cultivation and consumption of the superfood, mushrooms are recommended due to their high nutritive value, medicinal properties and ease of cultivation. This study was designed to investigate the knowledge, attitudes and practices toward mushrooms as food and food supplements among Klang Valley residents. Data were collected using a structured questionnaire from a total of 385 respondents. Results revealed that a significant association ($p < 0.05$) was found between level of knowledge and practices towards mushrooms as food and food supplements. Price, taste, and health benefits were the top three factors affecting participants' preference when choosing mushrooms, processed mushroom food products and mushroom supplements. Moreover, age and monthly income showed a significant association ($p < 0.05$) with level of knowledge, attitudes, and practices towards mushrooms as food and food supplements while ethnicity was significantly associated ($p < 0.05$) with both level of attitudes and practices only. In conclusion, Klang Valley residents exhibited a high level of knowledge towards fresh mushrooms and processed mushroom food products, however, the appreciation and utilisation of mushrooms were still lacking as both level of attitude and level of practices were at moderate level. Corrective measures such as increasing public education on mushrooms are hence of top priority.

1. Introduction

The term mushroom is widely used throughout the world to describe the fleshy, spore-bearing fruiting bodies of different species of macrofungi that belong to the Ascomycota and Basidiomycota phyla (Li *et al.*, 2007; Crystal, 2018). The mycelium, of these fungi can be found living parasitically on plants and animals or saprophytically on dead organic matters after heavy rain or a sudden change of temperature (Cunha *et al.*, 2011; Zied and Pardo-Giménez, 2017). Mushrooms can be categorized into 3 major groups according to their applications: edible mushrooms, medicinal mushrooms and wild mushroom (Zied and Pardo-Giménez, 2017). Mushrooms are cultivated in over 60 countries with China, Japan, the United States, Netherlands and India being the top 5 producers in 2020 (Rob, 2022). Notably, about 85% of the world's cultivated edible mushrooms is represented by only five genera: *Lentinula*, *Agaricus*,

Pleurotus, *Auricularia* and *Flammulina*, despite the fact that a wide variety of other edible mushrooms could also be cultivated commercially on a large scale (Beulah *et al.*, 2013; Zied and Pardo-Giménez, 2017).

Owing to their distinct umami flavour and unique textural properties, mushrooms are cherished as a culinary delicacy and considered as a potential alternative for meat and fishes (Asgar *et al.*, 2010). Nutritional benefits vary depending on the type of mushrooms. In generic, mushrooms are rich in protein, vitamins (B1, B2, B12, C, D and E), minerals, fiber and antioxidant, while low in calories and fat (Akindahunsi and Oyetayo, 2006; Valverde *et al.*, 2015). Not only they have been appreciated for their culinary and nutritional values, mushrooms are now increasingly treasured for their numerous significant medicinal properties, so that they are used not only as dietary food or functional food, but also in the form of dietary supplements,

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nutraceuticals and mycotherapy products (Wasser, 2014).

Some previous studies reported on the mushrooms' potential as a dietary supplement (or nutraceuticals) (Nallathamby *et al.*, 2018; Wong, 2018; Chong *et al.*, 2019); the knowledge and practices of wild edible mushrooms in Sabah (Foo *et al.*, 2018); and the level of knowledge and consumers' perception toward mushroom-based products in Malaysia (Amin *et al.*, 2017). However, studies on the level of knowledge, attitudes, and practices (KAP) about mushrooms as food and food supplements is still scarce in Malaysia. Hence, the aim of this study was to investigate the knowledge, attitudes and practices (KAP) toward mushrooms as food and food supplements among Klang Valley residents.

2. Materials and methods

2.1 Field study

A 7-day field study was undertaken in Klang Valley at retail outlets (Jaya Grocer, Aeon, Giant and Food Merchant), wet markets (Puteri Mart, Local Market Puchong Batu 14 and Pasar Pagi Taman Kinrara), pharmacies (Caring Pharmacy, Watsons Pharmacy and Aeon Wellness Pharmacy), vitamin and supplement stores (LAC Sunway Pyramid), and Chinese medicine stores (Xin An, Eu Yan Sang and Soon Thye Hang) to determine the types and forms of fresh mushrooms, processed mushroom food products and mushroom supplements available in the market. In addition, online field research was also conducted on Shopee, Lazada and Happy Fresh.

2.2 Data collection

A cross-sectional, questionnaire-based study was designed to assess the knowledge, attitudes and practices (KAP) toward mushrooms as food and food supplements among Klang Valley residents (Liu *et al.*, 2018; Lee *et al.*, 2021). The validated questionnaire was distributed to participants through online. There was a total of 28 questions in the questionnaire, included 5 questions on sociodemographic, 10 questions on knowledge, 3 questions on attitudes and 10 questions on practices. This study was only eligible for Klang Valley residents and respondents that were 18 years old and above. The convenience sampling method was adopted according to participants' availability and willingness to take part (Khan *et al.*, 2014; Haron *et al.*, 2021). Approval of the Taylor's University Ethical Committee was obtained before conducting the study (Reference No.: HEC 2022/123).

2.3 Statistical analyses

Statistical analysis was done using IBM SPSS Statistics 25. Simple descriptive statistics and Pearson's

chi-square test were used to test the hypothesis and to study the association between two qualitative variables. The chosen level of significance was set at $p < 0.05$.

3. Result and discussion

3.1 Field study

Field research found that there are 11 types of fresh mushrooms (button mushroom, shiitake mushroom, grey oyster mushroom, king eryngii mushroom, enoki mushroom, spiltgill mushroom, black fungus, snow fungus, bunashimeiji mushroom, maitake mushroom and lion's mane mushroom) available in Klang Valley, where they can be purchased from retail outlets, wet markets and online grocery shopping applications. Dried mushrooms (whole and sliced), dried fungus, mushroom seasoning, mushroom burger patty, mushroom and truffle paste, soup stocks, mushroom chips, instant soup, pasta sauces, canned mushrooms, mushroom frankfurters and fish balls as well as vegetarian mushroom oyster flavoured sauce were the types of processed mushroom food products found abundantly in Klang Valley. Mushroom supplements that were widely available in Klang Valley comes in powder and capsule form. Medicinal mushrooms used to make mushroom supplements sold locally include tiger milk mushroom (*L. rhinocerotis*), cordyceps (*C. sinensis*), *A. camphorata*, God's mushroom (*A. blazei*), Wild Yunzhi (*C. Versicolor*), and Reishi mushroom (*G. Lucidum*).

3.3 Sociodemographic characteristics

Table 1 visualizes the sociodemographic characteristics of the respondents. A total of 385 respondents participated in the study (Table 1). Results showed that majority of the respondents of this study fell within the age range of 18 to 25 (54.0%). As this study was conducted voluntarily, the best explanation for this phenomenon was that young adults in Klang Valley might have higher interest in this research topic as compared to respondents of other age range. A survey conducted on Generation Z (Gen Z, 10 to 25 years old) consumers reported that 72% of Gen Z see healthy eating as an integral part of their physical and mental health and with 71% making an effort to eat healthy food at home (Southey, 2021). Likewise, Walker (2017) mentioned Gen Z is one of the most health-conscious demographics to date. Additionally, the total proportion of female respondents (60%) were found higher than the proportion of male respondents (40%). This was believed to be closely related to the grocery shopping responsibility in each household. This can be supported by a study done by Tighe (2020), who reported the primary shopper in their households were female.

Table 1. Socio-demographic characteristics of respondents (n=385).

Variable		Frequency (n)	Percentage (%)
Age (year)	18 to 25	208	54.0
	26 to 45	126	32.7
	46 and above	51	13.2
Gender	Male	155	40.3
	Female	230	59.7
Ethnicity	Chinese	180	46.8
	Malay	133	34.5
	Indian	51	13.2
	Others	21	5.5
Highest Educational Qualification	Primary	4	1.0
	Secondary	56	14.5
	Tertiary	299	77.7
	Non-formal	26	6.8
Monthly Income Range	Less than RM1500	182	47.3
	RM1500 to RM3500	76	19.7
	RM3500 to RM5500	66	17.1
	More than RM5500	60	15.6
	Not comfortable to tell	1	0.3

3.4 Knowledge toward mushrooms as food and food supplements

According to Table 2, 60.5% of respondents possessed good knowledge, 37.4% possessed fair knowledge and 2.1% had poor knowledge on fresh mushrooms. Most of the respondents were aware that mushrooms are low in starch (73.8%), low in saturated fatty acids (78.2%), low in calories (91.7%), and contain higher protein content than most other vegetables and wild plants (72.5%). Continuously, 58.2% of respondents possessed good knowledge, 35.1% of respondents had fair knowledge and 6.8% showed poor knowledge on processed mushroom food products (Table 2). Majority of the participants (85.2%) were aware that processing mushrooms will increase shelf life of mushrooms. Further, 65.2% of them were aware that the nutritional quality of processed mushroom products is not as high as fresh mushrooms.

Subsequently, majority of participants' knowledge towards mushroom supplements were at fair level

(52.2%), while 36.4% showed poor level of knowledge and only 11.4% possessed good knowledge (Table 2). In fact, most of the respondents were aware that mushrooms supplements can be used to fight fatigue and depression (57.6%), to boost the immune system (89.9%) and to reduce the risk of cognitive decline (56.1%). However, 30.4% of respondents were unaware that mushroom supplements are able to combat and prevent SARS-CoV-2 (Covid-19). To summarize, Klang Valley residents had better knowledge on fresh mushrooms and processed mushroom food products as compared to mushroom supplements. Both fresh mushrooms and processed mushrooms are easily accessible in most retail

Table 2. Respondents' level of knowledge towards fresh mushrooms, processed mushroom food products and mushroom supplements (n=385).

Mushroom Products	Level of Knowledge	Frequency (n)	Percentage (%)	Mean Score
Fresh Mushroom	Poor Knowledge (0 to 4 Scores)	8	2.1	
	Fair Knowledge (4.1 to 8 Scores)	144	37.4	8.88
	Good Knowledge (8.1 to 12 Scores)	233	60.5	
Total		385	100	
Processed Mushroom Food Products	Poor Knowledge (0 to 4 Scores)	26	6.8	
	Fair Knowledge (4.1 to 8 Scores)	135	35.1	8.58
	Good Knowledge (8.1 to 12 Scores)	224	58.2	
Total		385	100	
Mushroom Supplements	Poor Knowledge (0 to 4 Scores)	140	36.4	
	Fair Knowledge (5 to 9 Scores)	201	52.2	5.52
	Good Knowledge (10 to 14 Scores)	44	11.4	
Total		385	100	

and online stores, resulting in higher level of knowledge among the residents since they were familiar with such products. On the other hand, mushroom supplements are considered as a novel product, and they were only available in certain pharmacies, vitamin and supplement stores and Chinese medicine stores. Thus, respondents' level of knowledge towards mushroom supplements were generally lower.

3.5 Attitudes toward mushrooms as food and food supplements

Of the respondents, 50.9% possessed moderate attitude (neutral) towards mushroom as food and food supplements, whereas 47.5% with good attitude, followed by 1.6% showed poor attitude (Table 3). Figure 1 depicts the top 3 reasons influencing Klang Valley resident's willingness to try a new mushroom product were price (77.7%), taste (74.5%) and health benefits (60.5%), followed by other factors such as product appearance (47.8%), packaging (39.0%), fear (26.2%), allergy concern (23.9%) and freshness (0.3%). Additional factors influencing consumer willingness and confidence to purchase a mushroom product include the existence of scientific authentication from recognised organisations and the Halal and MeSTI certificates issued by the Ministry of Health.

Table 3. Respondents' attitude towards mushroom as food and food supplements (n=385).

Attitude	Frequency (n)	Percentage (%)	Mean Score
Poor Attitude (0 to 13 Scores)	6	1.6	
Moderate Attitude (14 to 27 Scores)	196	50.9	27.44
Good Attitude (28 to 40 Scores)	183	47.5	
Total	385	100	

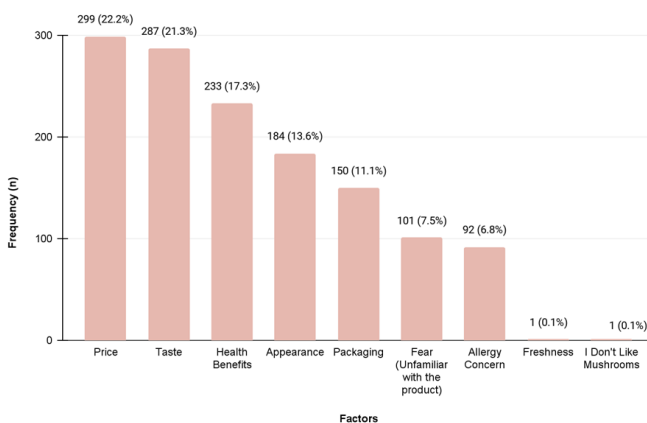


Figure 1. Factors affecting respondents' willingness to try new fresh mushrooms, processed mushroom products and mushroom supplements (n=385).

3.6 Practices toward mushrooms as food and food supplements

Table 4. Respondents' overall practice towards mushroom as food and food supplements (n=385).

Practice	Frequency (n)	Percentage (%)	Mean Score
Poor Practice (0 to 41 Scores)	8	2.1	
Moderate Practice (42 to 82 Scores)	274	71.2	72.43
Great Practice (83 to 123 Scores)	103	26.8	
Total	385	100	

Table 4 reveals that the majority of the Klang Valley residents (71.2%) had a moderate practice towards mushroom as food and food supplements, followed by 26.8% of great practices and 2.1% with poor practices. Enoki mushroom (17.6%) was the most regularly consumed fresh mushrooms, followed by button mushroom (13.6%), shiitake mushroom (11.8%), oyster mushroom (11.1%) and portobello mushroom (9.4%) (Table 5). In terms of processed mushroom food products, the top 5 products which Klang Valley residents regularly consume include mushroom pasta sauce (22.8%), instant soup (13.7%), canned mushroom (13.0%), mushroom chicken frankfurters (11.5%) and condensed mushroom soup/ dried mushroom (10.5%) (Table 5). On the other hand, more than half (57.1%) of the respondents stated that they do not have the practice of buying mushroom supplements.

Table 5. Top 5 most regularly consumed fresh mushroom and processed mushroom food products among Klang Valley residents (n=385).

Food	Frequency (n)	Percentage (%)
Enoki Mushroom	176	17.6
Button Mushroom (White or Brown)	136	13.6
Fresh Mushroom		
Shiitake Mushroom	118	11.8
Oyster Mushroom	111	11.1
Portobello Mushroom	94	9.4
Processed Mushroom Food Products		
Mushroom Pasta Sauce	121	22.8
Instant Soup	73	13.7
Canned Mushroom	69	13.0
Mushroom Chicken Frankfurters	61	11.5
Condensed Mushroom Soup	56	10.5
Dried Mushroom	56	10.5

Table 6. Association of demographic factors with level of knowledge towards mushroom as food and food supplement (n=385).

Variable	Level of Knowledge (Frequency, n)			P-value	
	Low	Fair	Good		
Age (year)	18 to 25	2 (0.5%)	161 (41.8%)	45 (11.7%)	0.000
	26 to 45	3 (0.8%)	91 (23.6%)	32 (8.3%)	
	46 and above	0 (0.0%)	18 (4.7%)	33 (8.6%)	
	Total	5 (1.3%)	270 (70.1%)	110 (28.6%)	
Gender	Male	3 (0.8%)	109 (28.3%)	43 (11.2%)	0.646
	Female	2 (0.5%)	161 (41.8%)	67 (17.4%)	
	Total	5 (1.3%)	270 (70.1%)	110 (28.6%)	
Ethnicity	Chinese	1 (0.3%)	133 (34.5%)	46 (11.9%)	0.517
	Malay	2 (0.5%)	88 (22.9%)	43 (11.2%)	
	Indian	1 (0.3%)	34 (8.8%)	16 (4.2%)	
	Others	1 (0.3%)	15 (3.9%)	5 (1.3%)	
	Total	5 (1.3%)	270 (70.1%)	110 (28.6%)	
Monthly Income Range	Less than RM1500	2 (0.5%)	146 (37.9%)	34 (8.8%)	0.000
	RM1500 to RM3500	3 (0.8%)	51 (13.2%)	22 (5.7%)	
	RM3500 to RM5500	0 (0.0%)	40 (10.4%)	26 (6.8%)	
	More than RM5500	0 (0.0%)	33 (8.6%)	27 (7.0%)	
	Not comfortable to tell	0 (0.0%)	0 (0.0%)	1 (0.3%)	
Total	5 (1.3%)	270 (70.1%)	110 (28.6%)		

Table 7. Association of demographic factors with level of attitude towards mushroom as food and food supplement (n=385).

Variable	Attitude (Frequency, n)			P-value	
	Poor	Moderate	Good		
Age (year)	18 to 25	3 (0.8%)	128 (33.2%)	77 (20.0%)	0.000
	26 to 45	2 (0.5%)	47 (12.2%)	77 (20.0%)	
	46 and above	1 (0.3%)	21 (5.5%)	29 (7.5%)	
	Total	6 (1.6%)	196 (50.9%)	183 (47.5%)	
Gender	Male	2 (0.5%)	85 (22.1%)	68 (17.7%)	0.441
	Female	4 (1.0%)	111 (28.8%)	115 (29.9%)	
	Total	6 (1.6%)	196 (50.9%)	183 (47.5%)	
Ethnicity	Chinese	4 (1.0%)	99 (25.7%)	77 (20.0%)	0.046
	Malay	1 (0.3%)	54 (14.0%)	78 (20.3%)	
	Indian	1 (0.3%)	28 (7.3%)	22 (5.7%)	
	Others	0 (0.0%)	15 (3.9%)	6 (1.6%)	
	Total	6 (1.6%)	196 (50.9%)	183 (47.5%)	
Monthly Income Range	Less than RM1500	4 (1.0%)	109 (28.3%)	69 (17.9%)	0.038
	RM1500 to RM3500	0 (0.0%)	34 (8.8%)	42 (10.9%)	
	RM3500 to RM5500	1 (0.3%)	30 (7.8%)	35 (9.1%)	
	More than RM5500	1 (0.3%)	22 (5.7%)	37 (9.6%)	
	Not comfortable to tell	0 (0.0%)	1 (0.3%)	0 (0.0%)	
Total	6 (1.6%)	196 (50.9%)	183 (47.5%)		

3.7 Association of demographic factors on level of knowledge, attitudes, and practices towards mushrooms as food and food supplements

A statistically significant association ($p < 0.05$) was reported between participants' age and level of knowledge and level of attitudes, respectively (Tables 6 and 7). On the contrary, there was no statistically significant association ($p > 0.05$) between gender and level of knowledge, as well as ethnicity and level of knowledge. In contrast, Foo *et al.* (2018) and Garibay-

Orijel *et al.* (2012) reported that gender showed significant association with level of knowledge, with female respondents being more knowledgeable towards mushrooms as compared to males. Further, significant association ($p < 0.05$) was reported between participants' ethnicity and level of attitude as well as monthly income range and level of attitude.

On the other hand, a statistically significant association ($p < 0.05$) revealed between respondent's age and level of practices, respondent's ethnicity and level of

Table 8. Association of demographic factors with level of practices towards mushroom as food and food supplements (n=385).

Variable	Practices (Frequency, n)			P-value	
	Poor	Moderate	Great		
Age (year)	18 to 25	2 (0.5%)	163 (42.3%)	43 (11.2%)	0.000
	26 to 45	6 (1.6%)	83 (21.6%)	37 (9.6%)	
	46 and above	0 (0.0%)	28 (7.3%)	23 (6.0%)	
	Total	8 (2.1%)	274 (71.2%)	103 (26.8%)	
Gender	Male	2 (0.5%)	108 (28.1%)	45 (11.7%)	0.507
	Female	6 (1.6%)	166 (43.1%)	58 (15.1%)	
	Total	8 (2.1%)	274 (71.2%)	103 (26.8%)	
Ethnicity	Chinese	2 (0.5%)	139 (36.1%)	39 (10.1%)	0.019
	Malay	5 (1.3%)	82 (21.3%)	46 (11.9%)	
	Indian	0 (0.0%)	35 (9.1%)	16 (4.2%)	
	Others	1 (0.3%)	18 (4.7%)	2 (0.5%)	
	Total	8 (1.6%)	274 (71.2%)	103 (26.8%)	
Monthly Income Range	Less than RM1500	2 (0.5%)	148 (38.4%)	32 (8.3%)	0.001
	RM1500 to RM3500	3 (0.8%)	39 (10.1%)	34 (8.8%)	
	RM3500 to RM5500	2 (0.5%)	46 (11.9%)	18 (4.7%)	
	More than RM5500	1 (0.3%)	40 (10.4%)	19 (4.9%)	
	Not comfortable to tell	0 (0.0%)	1 (0.3%)	0 (0.0%)	
Total	6 (1.6%)	196 (50.9%)	183 (47.5%)		

practices, as well as respondent's monthly income range and level of practices (Table 8). From the results, Malay was found to utilize mushrooms the most, this was believed that mushrooms have been widely used as food by indigenous and local communities in dishes like kerabu (a local salad), rendang and stir fry (Shyen and Mohammad, 2020).

4. Conclusion

In conclusion, there are 11 species of fresh mushrooms, 12 types of processed mushroom food products, and 2 forms of mushroom supplements

(powder and capsule) that are widely available in Klang Valley. There is a significant association ($p < 0.05$) between level of knowledge and level of practices towards mushrooms as food and food supplements. The findings of this study showed that although Klang Valley residents have a high level of knowledge towards fresh mushrooms and processed mushroom food products, appreciation and utilisation of mushrooms were still lacking as both level of attitude and level of practices were at moderate level. Mushrooms as food and food supplements were envisioned to be the potential source of a healthier diet tackling micronutrient deficiency, food insecurity and achieving sustainable food alternatives, hence corrective measures such as increasing public education towards mushrooms is crucial.

Conflict of interest

The authors declare no conflict of interest.

Acknowledgments

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