ORIGINAL ARTICLE

Evaluation of Antioxidant Properties, Knowledge, Attitude and Practice (KAP) on Selected Dietary Supplements (Barley Grass, Wheatgrass and *Chlorella vulgaris* powders)

Azrina Azlan[1,2], Wan Ying Gan[1], Hao Yuan Yoh[1], Sharmin Sultana[2]

[1] Department of Nutrition and Dietetics, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, Serdang 43400, Selangor, Malaysia
[2] Laboratory of Halal Science Research, Halal Products Research Institute, Universiti Putra Malaysia, 43400 UPM, Serdang, Selangor, Malaysia

ABSTRACT

Introduction: Three selected dietary supplements (DS), barley grass (BG), wheatgrass (WG), and *Chlorella vulgaris* (CV), are commercially available. However, more information is needed about the antioxidant properties of the three DS and their potential health benefits on adults' health and well-being. Thus, this study aimed to determine the antioxidant properties and adults' knowledge, attitudes and practices (KAP) of the three selected DS. **Methods:** In phase 1, an experimental study was conducted on antioxidant analysis, total phenolic content (TPC) and DPPH radical scavenging activity for the three DS. For phase 2, a cross-sectional survey (n=338) was conducted for the three DS through an online platform where convenience sampling was performed. **Results:** In phase 1, BG (2.83±0.50mg GAE/g DW) had the highest TPC, followed by WG (2.02±0.20mg GAE/g DW) and CV (1.74±0.65mg GAE/g DW); DPPH radical scavenging activity, BG (198.23±0.15µg/mL) and WG (177.25±0.17µg/mL) had lower IC50 compared to CV (1185.84±0.28µg/mL). Significant differences ($p<0.05$) were found between IC50 of the three DS and standards, butylated hydroxytoluene (24.51±0.37µg/mL) and quercetin (26.04±0.55µg/mL). While in phase 2, poor knowledge (51.5%), moderate attitude (39.6%), and poor practice (43.2%) levels were observed in most of the participants. Moreover, working adults reported higher scores in knowledge (3.70±1.51) compared to students (3.33±1.63, $p=0.037$). Males had higher scores (29.27±2.42) in attitude compared to females (28.49±2.68, $p=0.030$). Besides, participants who were single and completed tertiary education with 4-6 years of working experience showed better practice scores. The overall knowledge ($r=0.134$, $p=0.013$) and attitude ($r=0.273$, $p<0.001$) scores correlated significantly with practice scores. **Conclusion:** Participants' poor knowledge, moderate attitude, and inadequate practice in phase 2 caution against over-reliance on supplements, emphasizing the importance of an active lifestyle and balanced diet for optimal health and longevity.
Malaysian Journal of Medicine and Health Sciences (2023) 19(5):59-69. doi:10.47836/mjmhs19.5.10

Keywords: Knowledge, attitude, practices, antioxidants, dietary supplements

Corresponding Author:
Azrina Azlan, PhD
Email: azrinaaz@upm.edu.my
Tel: +603-97692466

INTRODUCTION

People have been searching for ways to improve their health conditions to live fulfilling and happier lives. Apart from practising and adopting healthy diets and physical activity, people have also been practising dietary supplements (DS), nutraceuticals (N), and functional foods (FF) to have better well-being of health. However, people are widely exposed to FF, N, and DS, but sometimes people need help to differentiate the variation between these products as most marketers use jargon to explain them.

FF can be defined as food products or beverages containing known or unknown biologically active compounds that provide clinically tested health benefits for managing or treating some chronic diseases (1). A few examples of FF in the market are fortified yoghurts and orange juices with enriched vitamins C and D (1). By contrast, DS is a single substance usually taken alone or in mixtures in which the body needs or lacks the specific micronutrient (such as calcium). Precisely, the Food and Drug Administration (FDA) defined DS as products that are taken orally containing a "dietary ingredient" (such as vitamins) which can supplement the diet (2). Finally, N is a food that provides medical or health benefits, including disease prevention and/or treatment (3). It is made from food or part of the food (such as a garlic capsule) (4).

Over the past few years, the demand for DS use has

gradually increased globally, reaching over 90 million US dollars (5). Besides, 75% of individuals in developing countries take one or more DS (6). In European countries, the DS intake prevalence was higher in northern than in the southern countries (7). Meanwhile, South Korea showed a high demand for taking DS, where 60% of people was higher than in other countries (7), whereas, in Malaysia, 25% of adults consumed DS (8).

In recent years, Malaysia has undergone rapid urbanization resulting in rapid dietary and DS intake changes. As a result, the consumption of dietary supplements grew steadily from RM 2.2 billion in 2015 to RM 3.7 billion in 2020 (9). In 2014, the prevalence rate of DS intake showed an increment from 23.8% to 28%, while food supplements increased from 24.8% to 34% as compared to the previous Malaysian Adult Nutrition Survey (MANS) in 2003 (8), which showed that Malaysia's DS markets had increased positively (10). In 2021, the prevalence of DS use was very high, approximately 55.4%, with vitamin C supplements (38.4%) being the most popular dietary supplement (9).

Since ancient times, plants have been well-known for high concentrations of phytochemicals (such as anthocyanins), which may protect against damage from free radicals. Here, phytochemical refers to the collective term for plant chemicals with varied structures and functions. Common sources of phytochemicals originating from the plant include fruits, vegetables, and whole grains. Phytochemicals possess great antioxidant potential; thus, they have recently received significant attention and interest from the public (11). Among them, BG, WG, and CV powders which belong to DS have gained the interest of researchers as they possess high antioxidant properties (12–14).

BG comes from the leafy part of the barley plant, produced from the plant Hordeum vulgare. Briefly, it takes ten days to grow into the plant, is capable of growing in various climatic conditions and contains abundant sources of nutritional value primarily harvested at a young age (13). Also, it is usually cultivated at 12 to 14 inches from the above-ground plant (15). BG is well known as a good source of phytonutrients and antioxidants as it contains high amounts of carotenoids and significant amounts of vitamins B1, B2, B3, B5, B6, and B12. It also contains folate, sometimes known as vitamin B9, and vitamins C and E (13,15).

WG originated from the plant *Triticum aestivum*. It is a thick, dry grass that looks like a straw in bright green colour and is widely grown throughout temperate regions of North America and Europe (16). It is also known as green blood because its high chlorophyll content gives wheatgrass products an unusual green hue (17). It is well-known as a potent health food because of its excellent benefits as it is packed with antioxidants and vitamins A, C, and E and minerals (E.g., magnesium). Besides, WG is well known as a complete vegan protein as it contains all the essential amino acids and thus can provide a balanced diet (14). WG is widely consumed as a superfood in the western world, containing more vitamin C than oranges and more vitamin A than carrots, and also it has powerful antioxidant properties (14, 17). Additionally, the potential therapeutic nutrients of wheatgrass are phenolic compounds and flavonoids such as ferulic acid, gallic acid, caffeic acid, and syringic acid (14).

CV powder is mainly found and extracted from fresh unicellular green algae called *Chlorella vulgaris*. It is a microscopic organism between 2 to 10µm, with a structure almost like a plant (18). Its structure comprises the cell wall, mitochondria, and chloroplasts, which can carry out photosynthesis (18). CV powder is a nutritious DS containing high vitamins, proteins, minerals, antioxidants and chlorophyll (18). In addition, a great variety of carotenoids (lutein, β-carotene, zeaxanthin, and α-carotene) can be found in CV (19). It is also often used as a DS to protect against metal toxicity, such as arsenic (20). BG, WG, and CV display a tremendous therapeutic effect since these DS have specialities that could benefit individuals' health and needs. These DS are usually consumed as powder, capsules, or tablets.

According to the World Health Organization, approximately 41 million people yearly, about 71% deceased from non-communicable diseases (NCDs) (21). Cardiovascular diseases account for most NCD deaths which are about 17.9 million people annually, followed by cancer-related diseases (9.3 million), respiratory diseases (3.9 million), and diabetes (1.5 million) (21). In Malaysia, ischemic heart disease is currently the primary leading cause of mortality reported in 2020, accounting for 17.0% of all deaths (22). Furthermore, as reported by the National Health and Morbidity Survey (NHMS) 2019, cardiovascular diseases (CVDs) such as stroke and coronary heart disease are the leading cause of death in Malaysia (23). Hence, NCDs in Malaysia is known as an alarming issue in which actions must be taken seriously. The beneficial effects of various plant materials, such as tea as a traditional herbal medicine for treating many diseases, including (CVDs) and diabetes mellitus, have been known since ancient times (24). Diabetes mellitus is the most prevalent metabolic disorder and is becoming a serious worldwide public health threat because it induces serious complications in several organs (24). It has been documented that antioxidants and several bioactive compounds present in DS materials may work against CVDs and diabetes mellitus. The possible mechanism behind this is that an antioxidant can be considered as a substance capable of repairing systems such as iron-transporting proteins by inhibiting a specific oxidizing enzyme that may react with oxidizing agents (24).

There are many types of DS with various health benefits,

known as "miracle cure" and "memory booster", which have created confusion for consumers who may not fully understand the purpose and application of the specific DS. Usually, DS has been massively advertised and commercialized as a miraculous product for some diseases, including NCDs. Hence, extensive advertising may lead to an accumulation of misleading information (24). For instance, in Malaysia, only three types of DS are available, with general information having nutritional, functional, and disease risk reduction benefits (25). In short, the claims of DS need to show beneficial effects in promoting good health and well-being (physical and mental), enhancing body structure/ function, relieving physiological discomfort, and/or reducing the risk of health-related conditions or diseases (25).

Additionally, the three selected DS (BG, WG, and CV) were chosen to be included in this study, as they are being promoted as the trios' products for the effect of "cleanse, fix and restore," following their antioxidant properties. They are also often promoted as "truly miracle foods" that help to reduce the stress of a modern lifestyle (13). However, more information about the contents (such as nutritional values) and properties claimed in these DS in Malaysia is needed. Thus, the antioxidant level of the three selected DS should be examined.

In Malaysia, there is yet to be a study done explicitly on the three selected DS as little is known about their effects (such as health benefits). Since these DS are not well-known enough, most consumers need to learn about their applications and benefits. Hence, the KAP towards three selected DS are also limited and needs to be better understood in Malaysia. Sien et al. (26) reported that data on DS in Asian countries is limited. There is abundant DS yet to be fully understood based on their safety, practice, food interaction, and usage in Malaysia. Therefore, this study aimed to determine the antioxidant properties and adults' KAP of the three selected DS.

MATERIALS AND METHODS

Study design

The current study comprised two phases: I and II. In the first phase, antioxidant activity analysis of three selected DS to verify the product claims on the label, such as supporting damaged and ageing cells and removing heavy metals, radiation, and chemical substances, was conducted. Hence, this study was carried out to compare and determine the concentration and antioxidant activity. The second phase of the study consisted of an online survey regarding the knowledge, attitudes and practices (KAP) on the three selected DS among Malaysian adult consumers.

Study sample

The BG, WG, and CV powders used in the study were commercial products purchased from various organic stores in the Selangor district, Malaysia. Among various brands, only one brand was sourced and chosen in this study. The products were purchased in powder form with weights of 100g for BG, WG, and 180g for CV powder.

Sample preparation

The extraction method has been selected from the previously published study with slight modifications (27). First, 50 g of each plant powder was briefly subjected to successive maceration using methanol (500 mL each) for 48 h at room temperature (27±1°C). Following the extraction step, filtration was carried out using a Bucker funnel and Whatman No.1 filter paper. Afterwards, the extracts were dried in a rotary evaporator under reduced pressure until dry. Moreover, a small amount of methanol (1 mL) was added to the dried extract from the rotary evaporator to collect the plant extracts. Subsequently, the plant extracts were dried using nitrogen gas before storing them in the fridge at 4°C and protected from light and humidity before further analysis.

Antioxidant activity analysis

Total phenolic content (TPC)

The TPC was determined per Mediani et al. (28) method with slight modifications. Hence, gallic acid was used as a standard curve to determine the TPC of the three selected DS (BG, WG, and CV) extracts. Followed by an aqueous sodium carbonate solution (7.5 %) and Folin-Ciocalteu reagent (FCR) (1:10) were prepared. Briefly, the plant extracts (5mg) of each selected DS were taken, mixed with 1000 µl of methanol and vortexed. Afterwards, 20µl of each sample of selected DS was transferred to each well of 96 well plates, followed by adding 100 µl of FCR and incubating for 5 minutes at room temperature. After that, 80 µl of 7.5 % sodium carbonate was added to each well. In total, 200 ul was required for each well of the 96 well plates. Later, the plate was incubated in the dark for 30 minutes at room temperature before the absorbance was measured at 765 nm using a microplate reader Tecan Infinite F200 Pro plate reader (Tecan, MΔnnedorf, Switzerland). All measurements were performed in triplicates, and the control would act as a blank. Then, The results were expressed in milligrams (mg) of gallic acid equivalents (GAE) per gram of dry weight (mg GAE/g DW). However, the concentration of gallic acid was expressed in mg/µl for better understanding. All measurements were performed in triplicates.

DPPH radical scavenging activity

This assay was conducted by Mediani et al. (28) with slight modifications to get better results. Briefly, 100 µl of sample extract was taken first from the prepared stock, followed by serial dilution. Then, 50 µl of sample extract (1000-15 µg/mL) and controls - quercetin and butylated hydroxytoluene (BHT) were added with the 100 µl of DPPH in the 96-well microplate. Next, the

mixture was left to stand in the dark for 30 minutes at room temperature before the absorbance was measured at 517nm using a microplate reader Tecan Infinite F200 Pro plate reader (Tecan, MΔnnedorf, Switzerland). Finally, the results were expressed in IC50 value (µg/mL), indicating the sample concentration required to scavenge 50% DPPH free radicals. All measurements were performed in triplicates.

The percentage (%) scavenging was calculated using the formula:

% Scavenging = [(A0 – A1) / A0] x 100

Where A0= absorbance of the control solution, A1= absorbance of extract/standard

Knowledge, attitudes, and practices (KAP) of the three selected dietary supplements (BG, WG, and CV)

Subjects

The target population of this study was Malaysian adults. The inclusion criteria were Malaysians aged 18 to 60 taking either any type or three selected dietary supplements. The exclusion criteria were pregnant and/or lactating women and individuals with NCDs.

Sample size determination

In this study, the determination of sample size used a Pearson correlation sample size formula was used (29), with the standard normal deviate for $Z\alpha = 1.96$; standard normal deviate for $Z\beta = 0.84$, r = the relationship between knowledge level and consumers' attitudes on three selected DS = 0.156 (30). A total of 320 participants were needed in this study.

Sampling

A convenience sampling method was used in this studyData were collected through google forms via online platforms such as email, WhatsApp, Instagram, and Facebook to minimize face-to-face interactions with the participants and reduce the spread of COVID-19.

KAP questionnaire

The KAP questionnaire was adapted with slight modifications from the literature (31). The KAP questionnaire consisted of four sections, including (A) socio-demographic characteristics, (B) knowledge of three selected DS, (C) attitudes of three selected DS, and (D) practices of three selected DS. Socio-demographic characteristics including sex, age, ethnicity, marital status, level of education, employment status, working experience, number of family members, and monthly household income were self-reported.

For knowledge section, it consisted of 10 items with the options "Yes", "No", and "Do not know". Zero-point was given to those who answered incorrectly and did not know the answer, whereas one point was given for the correct answer. The total score was calculated by summing up the scores of all items, in which the total score ranged from 0 to 10. Higher scores indicated that a participant knew about three selected DS. In this study, Cronbach's alpha value for the knowledge items was 0.728, indicating good internal consistency reliability.

The attitude section consisted of 10 items, using a 4-point Likert scale (1-strongly disagree, 2- disagree, 3-agree and 4-strongly agree). In addition, negative statements were reversely scored (4 - strongly disagree, 3 - disagree, 2 - agree, and 1 - strongly agree). The total score was calculated by summing up the scores of 10 items, in which the total score ranged from 1 to 40. Higher scores indicated a positive attitude level towards the three selected DS. In this study, Cronbach's alpha value for the attitude items was 0.707, indicating good internal consistency reliability.

The practice section consisted of 10 items with a 5-point Likert scale (1-never, 2 rarely, 3- sometimes, 4-often, and 5-always). Negative statements were scored reversely (5-never, 4- rarely, 3-sometimes, 2-often, and 1-always). The total score was calculated by summing up all the 10 items, in which the total score ranged from 1 to 50. Higher scores indicated a good level of practice with three selected DS. In this study, Cronbach's alpha value for the practice items was 0.710, indicating good internal consistency reliability.

Content validity

The supervisory committee conducted content validity in the Faculty of Medicine and Health Science of Universiti Putra Malaysia to ensure the appropriateness, ambiguity, and accuracy of each item in the KAP questionnaire. As a result, a total of 12 questions (four questions each on knowledge, attitude, and practice sections) out of 30 questions were asked for amendment before proceeding with the pre-testing of the questionnaire.

Ethical approval

This study was approved by Ethics Committee for Research Involving Human Subjects, Universiti Putra Malaysia (reference no.: JKEUPM-2022-121).

Pre-testing

Before going to the actual data collection, a pre-testing of the questionnaires by 30 adults who had experience taking any or three selected DS to determine the face validity of the KAP questionnaire. Cronbach's alpha value of ≥ 0.70 indicated good internal consistency reliability of the KAP questionnaire (32).

Data collection procedure

The data collection was administered through Google Forms from March 2022 to June 2022. The Google Forms were distributed via Facebook, Instagram, email, and WhatsApp. Adults who agreed to participate in the study were required to click the "I agree to participate

in the study" button and would proceed to fill up the questionnaire. The information sheet and informed consent form were attached to the first page of Google Forms. The participants had the right to decide their participation and withdrawal at any time if they felt uncomfortable with any items in the questionnaire.

Statistical analysis

Data were analysed using the IBM SPSS Statistics 26.0 (IBM Corp., Armonk, NY). Before analyzing the data, the skewness test of normality was used to assess the normality of the continuous data. A skewness value within ± 2.0 was considered the normal data distribution. All variables in the study were expressed in descriptive statistics, in which categorical variables were expressed in the form of frequencies and percentages, and the continuous variables were expressed in the form of means and standard deviations for normally distributed data as well as the median and interquartile range for non-normally distributed data. A one-way analysis of variance (ANOVA) test was used to compare the concentration of antioxidant levels between three selected DS. In addition, a post hoc test was conducted when the ANOVA's F-statistic was significant ($p<0.05$).

Similarly, the ANOVA test and independent-samples t-test were used to compare the KAP of the participants towards three selected DS between different socio-demographic characteristics. Besides, Pearson correlation tests were used to determine the relationships between knowledge and attitude with practice towards three selected DS among adult consumers. Statistical significance was set at $p<0.05$.

RESULTS

Phase 1: Antioxidant activity analysis

Total phenolic content (TPC)

It has been previously documented that the phenolic compounds found in plants, fruits, and microalgae have beneficial health effects that contribute to the antioxidant capability within the human diet, which are much higher than the vitamins (33). Therefore, TPC content is an essential indicator of determining the amounts of antioxidants in any sample (36). In this study, the TPC of these 3 DS was conducted using the Folin-Ciocalteu assay by constructing a standard curve with gallic acid (GA), considering the relationship between absorbance and concentration. The generated GA standard curve was linear y = 0.001x + 0.056; R2 = 0.9985.

Using the linear equation obtained from the standard curve, the TPC of each sample was determined and presented (Table I). The values are presented as milligram gallic acid equivalent/g dry weight extract (mg GAE/g DW). The range of TPC in samples was between 1.74 and 2.83mg GAE/g DW. In this study, it could be observed that the highest TPC was BG (2.83±0.50mg GAE/g DW), followed by WG (2.02±0.20mg GAE/g DW) and CV (1.74±0.65mg GAE/g DW). It could be observed that there were no significant differences ($p>0.05$) among the three samples.

Table I: Antioxidant profile – Total phenolic content and DPPH radical scavenging activity from barley grass, wheatgrass and *Chlorella vulgaris* powders

Samples (powders)	Extraction/ fractionation yield (g)	Total Phenolic Content (mg GAE/g DW)	DPPH Radical Scavenging Activity, (IC_{50}, µg/ml)
Barley grass	15.85	2.83±0.50[a]	198.23±0.15[a]
Wheatgrass	15.50	2.02±0.20[a]	177.25±0.17[a]
Chlorella vulgaris	14.75	1.74±0.65[a]	1185.84±0.28[b]
Quercetin	-	-	26.04±0.55[c]
BHT	-	-	24.51±0.37[c]

Abbreviations: BHT: Butylated hydroxytoluene, GAE: Gallic acid equivalent
Standard: Butylated hydroxytoluene (BHT) and quercetin
Data is represented as mean ± standard deviation (n=3)
Mean values of different superscript letters (*a, b* and *c*) are significantly different ($p<0.05$)

DPPH radical scavenging activity

The DPPH free radical scavenging activity ranged between 177.25µg/mL and 1185.84µg/mL among the three DS samples. The IC50 standards used in the study were quercetin (26.04µg/mL) and butylated hydroxytoluene (BHT) (24.5µg/mL). It could be observed that the lowest IC50 was WG (177.25+0.17µg/mL), followed by BG (198.23µg/mL) and CV (1185.84+0.28µg/mL). This data indicated that WG and BG had a higher concentration of radical scavenging capacity to adequately inhibit the DPPH radicals, where the least radical scavenging capacity was CV among the samples. The possible reason for these differences may be due to the nature of their raw ingredients. However, no significant differences were observed in the scavenging activity between BG and WG. However, there was a significant difference in the DPPH radical scavenging activity in the CV ($p<0.05$) compared to BG and WG. The standard curve of BG, WG, and CV can be viewed in Figure 2.

Phase 2: KAP regarding the three selected DS (BG, WG, and CV)

Socio-demographic characteristics of participants

The socio-demographic characteristics of participants are shown in Table II. A total of 338 Malaysian adults (19.5% males and 80.5% females) with a mean age of 24.45±5.74 years participated in the study. The majority were Chinese (83.7%), 92.6% were single, currently attaining or attained tertiary education (95.0%), 58.9% were students, and some of the students graduated with less than three years of working experience (82.5%). In addition, most were in the B40 and M40 groups (79.0%) and lived with 4 to 6 family members (80.2%).

Knowledge of participants' current usage of any type or three selected DS (BG, WG, and CV)

Table III shows the participants' knowledge, attitude and practice scores and classification regarding the three selected DS (BG, WG, and CV). The mean knowledge,

Table II: Socio-demographic characteristics of participants (n = 338)

Variables	n	%	Mean±SD
Age (years)			24.45±5.74
18-20	27	8.0	
21-23	156	46.2	
24-26	109	32.2	
≥27	46	13.6	
Sex			
Male	66	19.5	
Female	272	80.5	
Ethnicity			
Chinese	283	83.7	
Malay	37	10.9	
Indian	11	3.3	
Bumiputera Sarawak	3	0.9	
Bumiputera Sabah	4	1.2	
Marital status			
Single	313	92.6	
Married	23	6.8	
Divorced	2	0.6	
Level of education			
Secondary education	17	5.0	
Tertiary education	321	95.0	
Employment status			
Student	199	58.9	
Working	139	41.1	
Working experience (years)			2.58±5.0
≤3	279	82.5	
4-6	35	10.4	
7-9	8	2.4	
≥10	16	4.7	
Number of family members			
≤3	42	12.4	
4-6	271	80.2	
7-9	21	6.2	
≥10	4	1.2	
Monthly household income [a]			
B40 (≤RM4,850)	134	39.6	
M40 (RM4,851–RM10,959)	133	39.4	
T20 (≥RM10,960)	71	21.0	

Abbreviations: RM, Ringgit Malaysia
[a] Classified according to the Department of Statistics Malaysia

attitude and practice scores were 3.48±1.59, 28.64±2.65 and 32.94±3.29, respectivelyMore than half of the participants in this study (51.5%) had poor knowledge levels, 39.6% with a moderate attitude level, and 43.2% with a poor level of practice towards three selected DS.

Comparison of knowledge, attitude, and practice scores of the participants regarding the three selected dietary supplements (BG, WG and CV) between socio-demographic characteristics of the participants

Table IV compares knowledge scores between different socio-demographic characteristics of the participants regarding the three selected DS (BG, WG, and CV). There was a significant difference in knowledge scores between students and working participants (p=0.037). Higher knowledge scores toward the three selected DS were observed in those working (3.70±1.51) compared to students (3.33±1.63).

Table III Knowledge, attitude and practice scores and classification of the participants regarding any type of three selected dietary supplements (BG, WG, and CV) (n =338)

Variable	Mean±SD	Minimum	Maximum	n (%)
Knowledge score	**3.48±1.59**	**0.0**	**9.0**	
Good (7-9)				5 (1.5)
Moderate (4-6)				159 (47.0)
Poor (0-3)				174 (51.5)
Attitude score	**28.64±2.65**	**21.0**	**36.0**	
Good (30.01-36.0)				85 (25.1)
Moderate (27.01-30.0)				134 (39.6)
Poor (21.0-27.0)				119 (35.2)
Practice score	**32.94±3.29**	**22.0**	**42.0**	
Good (37.6-42.0)				101 (29.9)
Moderate (33.0-37.5)				91 (26.9)
Poor (22.0-32.9)				146 (43.2)

In terms of the comparison in attitude scores between different socio-demographic characteristics of the participants regarding the three selected DS (BG, WG, and CV), there was a significant difference in attitude scores between males and females (p=0.030), in which males (29.27±2.42) scored higher in the attitude scores compared to females (28.49±2.68).

In terms of the comparison in practice scores between different socio-demographic characteristics of the participants regarding the three selected DS (BG, WG, and CV), there were significant differences in practice scores between marital status (p=0.043) and working experiences (p=0.016). More specifically, in marital status, those who were single (33.03±3.21) showed a higher practice score than those who were married (31.43± 4.03). Besides, those with 4-6 years of working experience (33.14±2.97) and ≤3 years of working experience (33.06±3.28) showed higher practice scores as compared to those with ≥10 years of working experience (30.38±3.86). There was also a significant difference in practice scores between secondary and tertiary education (p<0.001). Participants with tertiary education (33.08±3.20) scored higher in practice than those who completed secondary education (32.18±4.75).

Relationships between knowledge and attitude with practice

Table V showed the results of Pearson's correlation which indicated significant positive relationships between knowledge and practice scores (r=0.134, p=0.013) as well as attitude and practice scores (r=0.273, p<0.001). The result of this study indicated that for participants with higher knowledge and attitude scores, their practice scores were also higher.

Table IV: Comparison of knowledge, attitude and practice scores of the participants regarding the three selected dietary supplements (BG, WG, and CV) between different socio-demographic characteristics (n =338)

Variables	Knowledge Mean±SD	p-value	Attitude Mean±SD	p-value	Practice Mean±SD	p-value
Age (years)		0.710		0.131		0.142
18-20	3.56±1.25		28.19±3.08		33.11±3.08	
21-23	3.53±1.58		28.74±2.74		33.28±3.25	
24-26	3.34±1.61		28.91±2.47		32.78±3.42	
≥27	3.61±1.78		27.91±2.36		32.04±3.10	
Sex		0.536		0.030*		0.620
Male	3.59±1.92		29.27±2.42		32.76±3.90	
Female	3.46±1.50		28.49±2.68		32.98±3.13	
Ethnicity		0.973		0.326		0.350
Chinese	3.50±1.58		28.52±2.61		33.07±3.30	
Malay	3.35±1.81		29.14±2.88		32.08±3.08	
Indian	3.64±1.43		29.18±2.36		32.91±3.42	
Bumiputera Sarawak	3.67±0.58		30.00±0.00		30.67±2.10	
Bumiputera Sabah	3.75±1.90		30.25±4.35		33.25±4.11	
Marital status		0.992		0.059		0.043*
Single	3.48±1.59		28.71±2.62		33.03±3.21[a]	
Married	3.52±1.62		27.48±2.83		31.43±4.03[a]	
Divorced	3.50±2.12		30.50±0.71		35.50±2.12	
Level of education		0.900		0.162		<0.001**
Secondary education	3.53±1.67		27.76±3.05		32.18±4.75	
Tertiary education	3.48±1.59		28.69±2.62		33.08±3.20	
Employment status		0.037*		0.096		0.805
Student	3.33±1.63		28.84±2.79		32.97±3.23	
Working	3.70±1.51		28.35±2.41		32.88±3.38	
Working experience (years)		0.220		0.145		0.016*
≤3	3.56±1.57		28.68±2.63		33.06±3.28[b]	
4-6	3.09±1.60		28.94±2.36		33.14±2.97[c]	
7-9	2.88±1.64		28.88±3.44		33.00±1.93	
≥10	3.25±1.88		27.19±2.97		30.38±3.86[bc]	
Number of family members		0.404		0.953		0.071
≤3	3.24±1.56		28.52±2.92		32.36±3.62	
4-6	3.49±1.59		28.64±2.60		33.11±3.23	
7-9	3.67±1.62		28.76±2.47		32.71±2.78	
≥10	4.50±1.00		29.25±4.43		29.50±4.67	
Monthly household income (RM)		0.378		0.423		0.232
≤RM4,850	3.38±1.73		28.77±2.69		33.15±3.35	
RM4,851–RM10,970	3.47±1.52		28.41±2.43		33.04±3.23	
≥RM10,971	3.70±1.41		28.83±2.94		32.35±3.25	

*Independent T-test and **One-way ANOVA were significant at $p<0.05$. [a] Significant difference between single and married in marital status,
[b] Significant difference of ≤3 years and ≥10 years in working experience, [c] Significant difference between 4-6 years and ≥10 years in working experience at $p<0.05$.

DISCUSSION

Antioxidant activity profile

In phase 1, an antioxidant activity analysis was conducted on the three selected DS (BG, WG, and CV). According to the findings, phenols are more soluble in polar solvents, so the selected DS extracts are highly concentrated with these compounds (35). Thus, methanolic extraction was used in this study on the selected dietary supplements, which showed to be more significantly efficient and more phenolic compounds and other types of antioxidant properties than hexane and acetate extraction (36). In addition, past investigations showed that aqueous extraction could dissolve more polar compounds, for example, phenolic compounds with low and medium molecular weights and medium polarity (37).

Besides, it was reported that young BG consists of various phenolic compounds, such as flavones, from the significant leaf antioxidants catechins and coumarins (38). Based on Table II, the TPC of BG was significantly higher than WG and CV. The findings of this study were similar to a study, revealing a higher TPC in BG juice

Table V: Correlations between knowledge scores and practice scores and between attitude scores and practice scores among participants regarding the selected dietary supplements (BG, WG and CV) (n =338)

Variables	Practice scores	p
	Correlation coefficient (r)	
Knowledge scores	0.134*	0.013
Attitude scores	0.273**	<0.001

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

than in WG and rice juices (39).

Lower IC50 was observed in both BG (198.23µg/mL) and WG (177.25µg/mL), showing both have a higher radical scavenging activity. The obtained IC50 of BG and WG from this study were within the range reported by others, such as plant extracts, IC50 of Desmostachya bipinnate and Hordeum vulgare (40). In this manner, the results depicted that BG and WG are more potent in the radical scavenging activity following these studies (41). On the other hand, it could be observed that CV had a higher IC50 and lower radical scavenging activity. CV has a lower antioxidant capacity than BG and WG, possibly due to the lower amounts of phenols, tannins, flavonoids and terpenoids (43). However, due to the lack of data comparing BG, WG and CV, more research is required to investigate the relationship between free radical scavenging activities among three selected DS.

Generally, the antioxidant activity in BG, WG and CV can be easily influenced and affected by light, cultivation timing, and cultivars (43). Besides, various studies have found that heat treatment can affect and alter the chemical structure of polyphenols, affecting the functions and capacities of the antioxidant properties (43). For example, a study reported that dry WG powder had a decreased total phenolic content and total flavonoid content compared to fresh WG due to thermosensitivity (44). In addition, factors such as algal species, geographical factors and seasonal and environmental variations could partially influence the antioxidant activity of CV (45).

KAP regarding the three selected dietary supplements (BG, WG and CV)

Results of this study showed that the participants had poor knowledge (51.5%), moderate attitude (39.6%) and poor practice (43.2%) toward the three selected DS (BG, WG and CV). Thus, participants in this study needed to have a better knowledge and understanding of the three selected DS. This data could be explained that the participants needed to learn about the functionality and benefits of the three selected DS but might know of other DS.

Subsequently, poor knowledge can be observed among the participants due to their inability to differentiate the differences and functions of the three selected DS, which the participants might not be willing to purchase for consumption. Furthermore, most participants come from something other than healthcare professional backgrounds, so they need to possess better knowledge and understanding of certain phytochemicals (such as flavonoids) and their functionalities. Therefore, the participants will only choose to consume the well-known and available DS in the current market in Malaysia. Moreover, price is also another factor in choosing DS. In the current study, we have also considered the prices of the DS as a predominant factor. Therefore, we are trying to use quite similar price products for this study; for example, BS and WS are similar (both RM 68.25 per 100 gm), while CV is relatively costlier (RM 184 per 200 gm). Therefore, consumers are more willing to stick to the current DS because of used to them and understand the functions and benefits (46). However, some healthcare professionals must possess the knowledge and experience of the three selected DS. They could not consult or advise consumers on the usage and benefits of these products (7). This leads to consumers needing more confidence to approach healthcare professionals for further clarification. Therefore, healthcare professionals should take the initiative to understand more about different DS available in the market to enhance their knowledge, advise consumers about the benefits and usage methods, and be complemented their daily lifestyles.

In terms of attitude, most of the participants in this study had moderate attitudes toward the three selected DS. The results were moderately positive in the attitude, but they needed to be a better understanding of the three selected DS. Due to a lack of understanding and perceptions of the exact functionalities and health benefits of some newly introduced DS, many healthcare professionals do not recommend incorporating them into individuals' diets and lifestyles. Besides, the possible interactions with certain medications or in case of overdosage is a severe concern for consumers (47). In terms of practice, most participants demonstrated a poor practice level, which their poor knowledge could influence.

Comparing the knowledge scores of the three selected DS between different socio-demographic factors, this study showed that higher knowledge scores regarding the three selected DS were observed in those working compared to students. The higher score in those working adults might be attributed to the stressed working environment or hectic working schedules. Therefore, they may be unable to meet daily requirements of nutrients (such as skipping meals). Thus, they might consume DS to ensure enough nutrients to stay healthy and meet daily nutrient requirements. Subsequently, the prevalence of DS consumption among working adults is increasing.

In this study, females were the majority of the subjects. However, the results showed that males had a higher score in attitude towards the three selected DS than

women. This may be due to the low number of male participants, causing differences in scoring in this study. Therefore, it can be observed that males had a higher score in attitudes. Furthermore, women were more concerned with their health. Therefore, they were keener to consume or purchase DS to improve their health status than males (48). It was also reported that women were more willing to invest in their health and beauty; hence, they were interested in trying different DS (48).

Furthermore, comparing the practice score towards the three selected DS and the socio-demographic characteristics showed significant differences ($p<0.05$) in marital status, education level and working experiences. Participants who were single and graduated from tertiary education with or without 4-6 working experiences tend to be more concerned about their health status. Previous study showed that individuals with higher educational levels and working experiences tend to be willing to invest in their health (49). Another reason is that working adults might have earned more income from their work, therefore, are more willing to invest in their health (49).

In addition, it was found that there was a relationship between knowledge and practice scores and attitude and practice scores. Knowledge can influence one behaviour as the intention is often influenced by how one perceives knowledge (50). It is also believed that educational background could determine an individual's knowledge level. A KAP study of Malay elderly on salt intake and its relationship with blood pressure described that Malay elderlies with better knowledge scores are more prone to reduce salt intake, thus improving their salt-related practices (50). Therefore, knowledge and attitude scores are related to the practices of individuals to either try or buy the three selected DS.

There are a few limitations to this study. In phase 1, TPC and DPPH radical scavenging activity may not provide sufficient information to validate the exact antioxidant activities of the three selected DS. More in vitro assays are needed, such as ferric reducing antioxidant power (FRAP) assay and superoxidase dismutase (SOD) activity assay, besides high-performance liquid chromatography HPLC analysis that offered different mechanisms needed. Also, only one brand was used in this study, which cannot represent the overall brands in comparing the other brands' exact amount of antioxidant activities. In phase 2, convenience sampling was used, and the results of this study could not be generalized to the whole population of adults in Malaysia.

Furthermore, the self-reported questionnaire used in this study could lead to biased findings, in which participants might provide socially desirable answers and experience recall bias. Besides, this study involved more Chinese than other ethnicities, which was not comparable to the ethnic distribution in Malaysia. Also, gender imbalance was observed in this study.

CONCLUSION

The present study investigated three types of DS available in the supermarkets. Results concluded that, in phase 1, the antioxidant activity of the three selected DS could provide the potential benefits to be incorporated into daily diet and lifestyle to improve general well-being and health. While in phase 2, most participants showed poor knowledge, moderate attitude, and poor practice towards the three selected DS. Over-relying on DS is not recommended. However, practising an active lifestyle and proper diet can achieve optimal health-being and longevity.

ACKNOWLEDGMENTS

We would like to thank all the participants involved in this study.

REFERENCES

1. Singharaj B. Health claims and functional food: The future of functional foods under FDA and EFSA regulation. In: Functional Foods for Chronic Diseases [Internet]. 2016. p. 410–24. Available from: https://www.researchgate.net/publication/318102868
2. Food and Drug Administration. FDA 101: Dietary Supplements [Internet]. 2021 [cited 2022 Jan 3]. Available from: https://www.fda.gov/consumers/consumer-updates/fda-101-dietary-supplements
3. Cencic A, Chingwaru W. The role of functional foods, nutraceuticals, and food supplements in intestinal health. Nutrients. 2010;2(6):611–25. doi: 10.3390/nu2060611.
4. Santini A, Novellino E. To nutraceuticals and back: Rethinking a concept. Foods. 2017;6(9):74. doi: 10.3390/foods6090074.
5. Hassan S, Egbuna C, Tijjani H, Ifemeje JC, Olisah MC, Patrick-Iwuanyanwu KC, et al. Dietary supplements: Types, health benefits, industry and regulation. In: Functional Foods and Nutraceuticals. Springer International Publishing; 2020. p. 23–38.
6. Barnes K, Ball L, Desbrow B, Alsharairi N, Ahmed F. Consumption and reasons for use of dietary supplements in an Australian university population. Nutrition. 2016;32(5):524–30. doi: 10.1016/j.nut.2015.10.022.
7. Intan N, Aziz SA, Fazira N, Shafii M, Azizam NA, Dzulkiply MR. Influencing factors in dietary supplement consumption among university students. Advances in Business Research International Journal. 2020;6(1):96–106. doi: 10.24191/abrij.v6i1.9945
8. Zaki NAM, Rasidi MN, Awaluddin SM, Hiong TG, Ismail H, Nor NSM. Prevalence and characteristic of dietary supplement users in Malaysia: Data from the Malaysian Adult Nutrition Survey (MANS) 2014. Global Journal of Health Science. 2018;10(12):127.

doi: 10.5539/gjhs.v10n12p127
9. Mohd Ashri, M. H., Abu Saad, H., & Adznam, S. N. Socio-demographic characteristics, body weight status and energy intake among users and non-users of dietary supplements among government employees in Putrajaya, Malaysia. Nutrients, 2019;13(7):2248. doi: 10.3390/nu13072248.
10. Birruntha. The dietary supplement market continues steady growth despite weak consumer sentiment [Internet]. The Malaysian Reserve. 2019 [cited 2021 Dec 13]. Available from: https://themalaysianreserve.com/2019/07/17/dietary-supplement-market-continues-steady-growth-despite-weak-consumer-sentiment/
11. Tadesse SA, Emire SA. Production and processing of antioxidant bioactive peptides: A driving force for the functional food market. Heliyon. 2020;6(8):1–11. doi: 10.1016/j.heliyon.2020.e04765.
12. Dantas DMM, Cahu TB, Oliveira CYB, Abadie-Guedes R, Roberto NA, Santana WM, et al. *Chlorella vulgaris* functional alcoholic beverage: Effect on propagation of cortical spreading depression and functional properties. PLoS One. 2021;16(8):e0255996. doi: 10.1371/journal.pone.0255996
13. Lahouar L, El-Bok S, Achour L. Therapeutic potential of young green barley leaves in prevention and treatment of chronic diseases: An overview. American Journal of Chinese Medicine. 2015;43(7):1311–29. doi: 10.1142/S0192415X15500743.
14. Shailja C, Hemlata K, Gitika C. Wheatgrass (Triticum aestivum Linn.): A potential substitute of human blood in traditional system of medicine. Asian Journal of Pharmaceutical and Clinical Research. 2021;14(6):1–5. doi: 10.22159/ajpcr.2021.v14i6.41575
15. Qamar A, Saeed F, Tahir-Nadeem M, Hussain AI, Niaz B, Khan AU, et al. Exploring the phytochemical profile of green grasses with special reference to antioxidant properties. International Journal of Food Properties. 2018;21(1):2566–77. doi: 10.1080/10942912.2018.1540990
16. Durairaj V, Hoda M, Shakya G, Babu SPP, Rajagopalan R. Phytochemical screening and analysis of antioxidant properties of aqueous extract of wheatgrass. Asian Pacific Journal of Tropical Medicine. 2014;7: S398–404. doi: 10.1016/S1995-7645(14)60265-0.
17. Gore RD, Palaskar SJ, Bartake AR. Wheatgrass: Green blood can help to fight cancer. Journal of Clinical Diagnosis and Research. 2017;11(6):40–2. doi: 10.7860/JCDR/2017/26316.10057.
18. Coronado-Reyes JA, Salazar-Torres JA, Juarez-Campos B, Gonzalez-Hernandez JC. Chlorella vulgaris, a microalgae important to be used in Biotechnology: a review. Food Science and Technology. 2020;1–11. doi; 10.1590/fst.37320
19. Jung HY, Ok HM, Park MY, Kim JY, Kwon O. Bioavailability of carotenoids from chlorella powder in healthy subjects: A comparison with marigold petal extract. Journal of Functional Foods. 2016;21:27–35. doi: 10.1016/j.jff.2015.11.036
20. Zahran E, Risha E. Modulatory role of dietary *Chlorella vulgaris* powder against arsenic-induced immunotoxicity and oxidative stress in Nile tilapia (Oreochromis niloticus). Fish Shellfish Immunology. 2014;41(2):654–62. doi: 10.1016/j.fsi.2014.09.035
21. World Health Organization. Non-communicable diseases [Internet]. World Health Organization. 2021 [cited 2021 Dec 9]. Available from: https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases
22. Department of Statistics Malaysia. Statistics on Causes of Death, Malaysia, 2020 [Internet]. 2020 [cited 2022 Jan 13]. Available from: https://www.dosm.gov.my/v1/index.php?r=column/cthemeByCat&cat=401&bul_id=QTU5T0dKQ1g4MHYxd3ZpMzhEMzdRdz09&menu_id=L0pheU43NWJwRWVSZklWdzQ4TlhUUT09
23. Institute for Public Health. National Health and Morbidity Survey (NHMS) 2019: Non-communicable diseases, healthcare demand, and health literacy— Key Findings. 2020.
24. Karbownik MS, Paul E, Nowicka M, Nowicka Z, Kowalczyk RP, Kowalczyk E, et al. Knowledge about dietary supplements and trust in advertising them: Development and validation of the questionnaires and preliminary results of the association between the constructs. PLoS One. 2019;14(6):1–24. doi: 10.1371/journal.pone.0218398
25. Azlan A, Sultana S, Huei CS, Razman MR. Antioxidant, Anti-Obesity, Nutritional and Other Beneficial Effects of Different Chili Pepper: A Review. Molecules. 2022;27(3):898. doi:10.3390/molecules27030898
26. Sien YP, Sahril N, Abdul Mutalip MH, Zaki NAM, Abdul Ghaffar S. Determinants of dietary supplements use among adolescents in Malaysia. Asia Pacific Journal of Public Health. 2014;26(5):36–43. doi: 10.1177/1010539514543681.
27. Panthi M, Subba RK, Raut B, Khanal DP, Koirala N. Bioactivity evaluations of leaf extract fractions from young barley grass and correlation with their phytochemical profiles. BMC Complement Medicine and Therapeutics. 2020;20(1):64. doi: 10.1186/s12906-020-2862-4.
28. Mediani A, Abas F, Tan CP, Khatib A. Effects of different drying methods and storage time on free radical scavenging activity and total phenolic content of Cosmos caudatus. Antioxidants. 2014;3(2):358. doi: 10.3390/antiox3020358.
29. Hulley SB, Cummings SR, Browner WS, Grady D, Newman TB. Designing clinical research: An epidemiologic approach. 4th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2013. 79 p.
30. Masuku S, Lan SJJ. Nutritional knowledge, attitude, and practices among pregnant and lactating women living with HIV in the Manzini Region

of Swaziland. Journal of Health Population and Nutrition. 2014;32(2):261–9.
31. Mohsen H, Yazbeck N, Al-Jawaldeh A, Chahine NB, Hamieh H, Mourad Y, et al. Knowledge, attitudes, and practices related to dietary supplementation, before and during the COVID-19 pandemic: Findings from a cross-sectional survey in the Lebanese population. Int J Environ Res Public Health. 2021;18(16):8856. doi: 10.3390/ijerph18168856.
32. Pallant J. SPSS survival manual: A step-by-step guide to data analysis using SPSS for windows. 7th ed. Vol. 7th Edition. Routledge; 2020.
33. Zakaria SM, Mustapa Kamal SM, Harun MR, Omar R, Siajam SI. Extraction of phenolic compounds from Chlorella sp. microalgae using pressurized hot water: kinetics study. Biomass Conversation and Biorefining. 2020;12(6):2081–9. doi: 10.1007/s13399-020-01027-y
34. Johari MA, Khong HY. Total phenolic content and antioxidant and antibacterial activities of Pereskia bleo. Advances in Pharmacological Science. 2019; 4: 1–4. doi: 10.1155/2019/7428593.
35. Haminiuk CWI, Plata-Oviedo MSV, de Mattos G, Carpes ST, Branco IG. Extraction and quantification of phenolic acids and flavonols from Eugenia pyriformis using different solvents. Journal of Food Science and Technology. 2014;51(10):2862. doi: 10.1007/s13197-012-0759-z
36. Jerez-Martel I, Garcнa-Poza S, Rodrнguez-Martel G, Rico M, Afonso-Olivares C, Gymez-Pinchetti JL. Phenolic profile and antioxidant activity of crude extracts from microalgae and cyanobacteria strains. Journal of Food Quality. 2017;6:1–9. doi: 10.1155/2017/292450
37. Ove TA, Khatun AA, Saifullah S bin, Ahmed M. Effectiveness of solvent extraction on phytochemicals and antioxidant activities from fresh and dried wheatgrass. European Journal of Nutrition and Food Safety. 2021;13(2):1–10. doi: 10.9734/EJNFS/2021/v13i230370
38. Czerwonka A, Kawka K, Cykier K, Lemieszek MK, Rzeski W. Evaluation of anticancer activity of water and juice extracts of young Hordeum vulgare in human cancer cell lines HT-29 and A549. Annals of Agricultural and Environmental Medicine. 2017;24(2):345–9. doi: 10.26444/aaem/74714
39. Wangcharoen W, Phimphilai S. Chlorophyll and total phenolic contents, antioxidant activities and consumer acceptance test of processed grass drinks. Journal of Food Science and Technology. 2016;53(12):4135. doi:10.1007/s13197-016-2380-z
40. Nepal P, Singh M, Baniya A, Singh S, Sainju HK, Shrestha R. Comparative antioxidant antimicrobial and phytochemical assessments of leaves of Desmostachya bipinnata L. Stapf, Hordeum vulgare L. and Drepanostachyum falcatum (Nees) Keng f. Nepal Journal of Biotechnology. 2018;2(0):1–10. doi: 10.3126/njb.v6i1.22331
41. Parit SB, Dawkar V v., Tanpure RS, Pai SR, Chougale AD. Nutritional quality and antioxidant activity of wheatgrass (Triticum aestivum) unwrap by proteome profiling and DPPH and FRAP assays. Journal of Food Science. 2018;83(8):2127–39. doi: 10.1111/1750-3841.14224
42. Takyar Taghavi MB, Haghighat Khajavi S, Safari R. Evaluation of antioxidant properties of *Chlorella vulgaris* and Spirulina platensis and their application in order to extend the shelf life of rainbow trout (Oncorhynchus mykiss) fillets during refrigerated storage. LWT Food Science and Nutrition. 2019;100:244–9. doi: 10.1016/j.lwt.2018.10.079
43. Park MJ, Seo WD, Kang YH. The antioxidant properties of four Korean barley cultivars at different harvest times and profiling of major metabolites. Journal of Agricultural Science. 2015;7(10):94. doi: 10.5539/jas.v7n10p94
44. Orphanides A, Goulas V, Gekas V. Effect of drying method on the phenolic content and antioxidant capacity of spearmint. Czech Journal of Food Sciences. 2013;31(5):509–13. doi:10.17221/526/2012-CJFS
45. Machu L, Misurcova L, Ambrozova JV, Orsavova J, Mlcek J, Sochor J, et al. Phenolic content and antioxidant capacity in algal food products. Molecules. 2015;20(1):1118. doi: 10.3390/molecules20011118.
46. Homer PM, Mukherjee S. The impact of dietary supplement form and dosage on perceived efficacy. Journal of Consumer Marketing. 2018;35(2):228–38.
47. Ghazzawi HAl, Hazem ESA, Amawi AT. Evaluation of knowledge, attitudes, and practices related to dietary supplement intake among college students: A cross-sectional study. Journal of Clinical and Diagnostic Research. 2022;16(6):11–7. doi: 10.7860/JCDR/2022/44287.16428
48. Kołodziej G, Cyran-Grzebyk B, Majewska J, Kołodziej K. Knowledge concerning dietary supplements among general public. Biomedicine Research International. 2019; 6:1–12. doi: 10.1155/2019/9629531
49. Nasreddine L, Akl C, Al-Shaar L, Almedawar MM, Isma'eel H. Consumer knowledge, attitudes and salt-related behavior in the Middle-East: The case of Lebanon. Nutrients. 2014;6(11):5079. doi: 10.3390/nu6115079.
50. Zainal ZNA, Mohd Saat NZ, Haron H. Survey on salt content in selected food products of fast-food restaurants and determination of salt intake awareness among fast food consumers in Klang Valley. Malaysian Journal of Nutrition. 2021;27(3).