

ORIGINAL ARTICLE

Perceptual Analyses of the Potential Alternative Remedy of *Bambusa beecheyana* as a Health Supplement.

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Abstract

Introduction: Biochemical research on naturally derived compounds has demonstrated the potential of bamboo shoots from *Bambusa beecheyana* as a source of valuable components, including anticoagulants, antioxidants, antimicrobials, anti-inflammatory agents, and anticancer agents. Natural health supplements are attracting increased interest due to their environmentally sustainable processing and growing public demand. **Methods:** This cross-sectional study aims to investigate awareness, usage, and public perception of bamboo shoots as health supplements among Malaysians, with a particular focus on factors influencing their consumption. An online survey using a self-administered questionnaire was conducted among Malaysians, via purposive and snowball sampling. A total of 478 responses were collected, of which 418 were deemed usable, with a response rate of 87.45%. **Results:** Most respondents recognised bamboo shoots as an ingredient in local cuisine, but many were unsure about their specific health properties. Chi-square analyses showed statistically significant associations ($p \leq 0.05$) between reasons for consuming bamboo shoots and awareness, usage, and perception variables, although effect sizes were generally small (Cramér's $V = 0.06$ – 0.16). The findings indicate a significant opportunity for researchers, inventors, producers, and marketers to raise market awareness and educate the public about the nutritional composition of bamboo shoots, which contain substantial amounts of protein, fibre, vitamins, minerals, and various nutraceuticals, including phenols and phytosterols. **Conclusions:** These findings support the need for nutritional information labels on bioproducts made from natural resources, particularly *Bambusa beecheyana* bamboo shoots, for daily supplementation and medical consideration.

Keywords: Bamboo shoots, *Bambusa beecheyana*, Health awareness, Health perception, Health supplement.



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Introduction

Bamboo shoots are a traditional cuisine in many countries despite being considered taboo among many indigenous communities in Sarawak, Malaysia, especially for women during their confinement [1, 2]. People worldwide consume bamboo shoots because of their low fat, high dietary fibre, and high potassium content, carbohydrates, vitamins, and minerals [3, 4]. Various Asian recipes use the edible shoots of bamboo plants. *Bambusa vulgaris* and *Phyllostachys edulis* are two of the common edible bamboo species used in cooking; they are often boiled, soaked, cooked, or pickled before being used in meals like stir-fries, curries, soups, and salads. At present, the growing trend of health-conscious consumers has resulted in a search for natural sources rich in nutrients, antioxidants, and bioactive chemicals to produce nutritious food products. Therefore, the nutritional and therapeutic properties of the bamboo shoots could also cater to the demand for a more nutritious diet and cost-effective health treatment. This health-conscious trend has spurred the development of functional foods, which may provide health advantages while also reducing the risk of illness and disorder development [5]. As a result, bamboo shoots are recognised as having tremendous potential in the pharmaceutical industry [6], and the food industry is working to develop healthier foods that offer proven health, economic, and social benefits [7]. Notably, the international export market for bamboo is worth US\$68.8 billion, while the export market for bamboo shoots reached US\$2 billion in 2020, as reported by the local tabloid *Berita Harian*, indicating high economic potential for value-added bamboo-based lumber and processed food (bamboo shoot) industries.

The key biomolecules present in bamboo shoots, for instance, are phenols, phytosterols, and dietary fibres, which can provide additional health benefits when consumed regularly. Biomedical studies on the health-benefiting effects of bamboo shoots have discovered that the presence of high amounts of vitamins,

carbohydrates, proteins, and minerals, as well as their ease of availability to the public, may help reduce rural nutritional shortfalls [8, 9]. Bamboo also contains essential amino acids, as well as selenium, a potent antioxidant, and potassium, a heart-healthy mineral [8, 9]. The nutritional and bioactive constituents of bamboo shoots have been linked to various health benefits, including lower blood pressure and cholesterol; increased appetite; anti-cancer and anti-diabetic properties; and lowering the risk of cardiovascular disease, hypertension, obesity, cancer, and certain gastrointestinal disorders; lowering blood sugar levels, promoting regularity, preventing constipation, and having antihyperglycaemic and immunomodulatory properties [8, 9, 10, 11].

In addition, consuming varied amounts of bamboo shoots could increase dietary fibre in food and affect its nutritional content, cooking qualities, and sensory acceptance [3, 4]. Furthermore, young bamboo shoots contain a high nutritional and bioactive component content and can play an important role in reducing micronutrient deficiency through food fortification [9]. However, raw bamboo shoots may be hazardous; hence, commercial items are processed using several methods, including fermentation, drying, canning, steaming, roasting, blanching, and pickling [10, 5]. Given the presence of taxiphyllin, a cyanogenic glycoside found in raw shoots, and its deleterious impact on human health, new processing procedures based on scientific input are required [10, 5]. Furthermore, because of the lignification factor, it is difficult to maintain the freshness of bamboo shoots [5], and the bioavailability of nutrients and other extracts from bamboo shoot biomass depends on various factors, including compositions, structures, and functional groups [11].

A prior study [4] suggests that regular consumption of bamboo shoots lowers reproductive health issues in females. Fortunately, there is only a minimal risk of interference with

male and female reproductive function when bamboo shoots are included in supplements; therefore, further understanding of the cause-and-effect relationship regarding these health issues requires medical attention and research. Furthermore, portions of the bamboo are available for medical applications, and diverse extraction methods imply that bamboo shoots have a high potential for creating various extracts with functional utility in medicine [12]. Bamboo shoots are mostly employed in native communities for agricultural purposes, fencing materials, and raw materials for home usage [13]. Nonetheless, bamboo shoots are important in traditional Asian medicine, particularly in China and Japan.

The Asia-Pacific Priority Survey in 2023 reported that 79% of Malaysian respondents expressed concerns regarding health and demonstrated increased health consciousness. Additionally, this survey showed that Malaysians are willing to spend more on health- and wellness-related activities, such as choosing healthier foods, buying and consuming dietary supplements, getting regular check-ups, seeking mental health consultations, and consulting experts. Conversely, bio-products present significant economic potential as dietary supplements, and we foresee their capacity for further research in naturally derived natural chemicals. Understanding the characteristics of dietary supplement consumers, their degrees of awareness, and product usage rates is critical in deciding the strategy for healthcare providers, manufacturers, and the government [15, 16, 17]. Many studies on dietary supplement use have not investigated the motivations behind consumers' decisions to seek supplemental intake of essential nutrients and other food components, resulting in a lack of scientific understanding of these motivations. Numerous surveys on supplement users' health-related characteristics have found that supplement use is associated with various habits or characteristics considered components of a healthy lifestyle, including attempts to make

better food choices [18, 19]. In contrast, for some people, taking supplements can be a risk rather than a benefit. In principle, taking too many vitamins and minerals from supplements might cause neurological abnormalities, gastrointestinal problems, liver toxicity, birth deformities, and drug interactions [20]. Likewise, the bamboo shoots of *Bambusa beecheyana* foresee their potential for extensive research and offer promising commercial value as health supplements. Particularly, the public's readiness to consume bamboo shoots of *Bambusa beecheyana* as a health supplement is a key factor in ensuring a return on research investment. Hence, it is pertinent to investigate the awareness, usage, and public perception of bamboo shoots as health supplements among Malaysians.

Materials and methods

Study design and setting

This cross-sectional survey employed a self-administered internet questionnaire conducted among the Malaysian public, specifically health supplement consumers. As there is no database record for health supplement consumers in Malaysia, a non-probability sampling approach was necessary. The initial screening identified that individuals aged 15 to 20 are likely to consider and utilise nutritional supplements to maintain their health, particularly during the COVID-19 pandemic when people are believed to be highly concerned about the global health phenomenon [14]. Thus, this study used a purposive selection technique targeting Malaysian respondents between the ages of 15 and 64, as well as those of working age defined by the Statistics Department of Malaysia. According to a study on dietary supplements among Malaysians [21], dietary supplement use is common among Malaysians aged 20 years and older. The snowball sampling method was employed to conduct the survey among the public. This non-probability sampling strategy was employed due to the unidentified identities of the targeted respondents.

Ethical Considerations

This study was reviewed and approved by the Institutional Review Board (IRB) of Universiti Teknologi MARA [IRB approval number: IOO-TNCPI/PRI 16/6/2 (054/2021) dated 1st October 2021].

The research protocols complied with the World Medical Association's (WMA) Declaration of Helsinki regarding ethical principles for medical research involving human subjects. Informed consent was obtained explicitly through a mandatory consent checkbox at the beginning of the online questionnaire; participants could not proceed without providing consent. The questionnaire did not require personal identification to ensure respondent anonymity. All participants and survey data were anonymised in accordance with the retrospective study design.

Sample size and sampling

According to Krejcie & Morgan [22], a 384-sample size is the minimal number of required samples for a population greater than a million to ensure the rationality of the data analysis. Respondents were randomly recruited by the enumerators, and those who were later contacted subsequently approached the targeted groups through their co-workers, family, and friends to facilitate the dissemination of the invitation email and online questionnaire link to their networks. The study collected 478 responses between October 2021 and January 2022 during the COVID-19 pandemic. Of the total responses, 418 were deemed usable, resulting in a response rate of 87.45%. The remaining responses were excluded from the dataset due to over 30% incompleteness, likely because respondents closed the browser prior to submitting the questionnaire.

Data collection instrument

The measurement instruments for this study were duly adopted from Cruz's (2011) [16] survey on food supplements. The demographic section of the survey asked about age, race, gender, employment, educational background, monthly income, and whether or not they take health

supplements. The paper examined respondents' awareness, usage, and attitudes or beliefs regarding their motivation for consuming bamboo shoots through a descriptive listing of 18 statements. Each statement was evaluated based on a defined set of responses. For example, in a statement regarding reasons for consuming bamboo shoots, the measured scale ranges from 1 (staying healthy) to 7 (accessories), with the following specific options: 1 (staying healthy), 2 (medical recommendations), 3 (realising the nutrition contained in bamboo shoots), 4 (just a dish), 5 (for crafts and art), 6 (medicine), and 7 (accessories). However, options 5, 6, and 7 (crafts/art, medicine, and accessories) were selected by very few respondents (<5% each), and preliminary cross-tabulation revealed expected cell counts below 5, violating chi-square assumptions. These three options were therefore collapsed into a single category ('Craft or art'), resulting in the five analytical categories reported in Table 2: staying healthy, medical recommendation, realising the nutrition, just as dishes, and craft or art. For construct validity, ten close friends, family members, and coworkers evaluated the questionnaire. Two academicians and an expert in chemistry subsequently verified the validity of the contents. The final questionnaire was refined and tuned accordingly to the construct and content validity assessment.

Data analysis

Differences in distribution among groups regarding the frequency of a demographic characteristic related to awareness, usage, and public perception of bamboo shoots as health supplements among Malaysians were analysed using the chi-squared (χ^2) test, and the results were reported with a p-value. The association between categorical variables was examined using the Pearson chi-square test, which determines the statistical significance of the results in a crosstabulation. The 5% significance level ($\alpha = 0.05$) was established as the 95% confidence level. The effect size of the investigated variables is identified by the

Cramer's V values (ϕ_c) for the nominal/categorical data and the Spearman's rho (ρ) for ordinal data. Bonferroni correction was applied to adjust for multiple comparisons (17 tests), with the adjusted significance threshold set at $p < 0.003$.

The estimated internal consistency of the data was indicated by a Cronbach's alpha reliability coefficient, which is considered significant if the value (α) exceeds 0.70, based on the combination of the observed items as a scale [23]. However, it should be noted that not all constructs were designed as scales; some statements served as individual constructs to describe respondents' awareness, usage, and perceptions. The data were analysed using SPSS (Statistical Package for Social Sciences, version 24).

Results

Demographic profile

Table 1a indicates that 49.0% of respondents were aged between 21 and 30 years, 50.2% identified as male, 60.3% were Malays, 41.1% held a bachelor's degree, 51.0% reported no monthly income, 38.8% were employed, 70.1% resided in Sarawak, and 61.5% stated they did not consume health supplements. The sample was geographically concentrated in Sarawak (70.1%), with Sabah (8.1%), Peninsular Malaysia (20.6%), and the Federal Territory (1.2%) collectively accounting for less than 30% of respondents. Ethnically, the sample was skewed toward Malay respondents (60.3%), while Chinese (5.0%), Indian (1.2%), and other ethnic groups (33.5%) were represented in proportions that differ from the national population distribution. In terms of age, the sample was dominated by respondents aged 21–30 years (49.0%) and ≤ 20 years (28.2%), together comprising 77.2% of the sample, with only 8.1% aged 31–40 and 14.6% aged 41 and above. Slightly more than half of respondents (51.0%) reported no monthly income, consistent with the high proportion of full-time students (50.2%).

Table 1b summarises the reliability coefficients for the variables examined. The reason-for-consumption scale (7 items, $\alpha = 0.756$), awareness scale (5 items, $\alpha = 0.829$), and usage/information scale (2 items, $\alpha = 0.822$) all demonstrated acceptable internal consistency ($\alpha > 0.70$). The perception scale (11 items) yielded an extremely high alpha ($\alpha = 0.993$), which may indicate item redundancy or multicollinearity rather than genuine internal consistency; this issue is addressed in the Limitations section.

Awareness, usage, and perception

Table 2 shows descriptively that the majority of respondents (40.0%) claimed to consume bamboo shoots because they recognised the nutrition contained in them. Most of the respondents (39.7%) claimed that they were very familiar with the shoot and could recognise the bamboo shoot; 28.5% had never consumed bamboo shoot; 34.4% were unsure about the health properties of bamboo shoots; and 33.3% claimed that they were familiar with *Gigantochloa*, one of the bamboo varieties. 35.9% of respondents claimed that being easy to use was one of the main reasons to purchase bamboo shoots, and 39.7% claimed that they were getting information about bamboo shoots through advertisements. The majority (45.2%) of the respondents mostly believed that bamboo shoots have the ability to cure gallbladder disorders; 49.0% believed that bamboo shoots are a health remedy to prevent cancer, especially when they can be used as a health supplement; and 41.1% believed that bamboo shoots provide a valuable health benefit as antibiotics.

Regarding the preferred form of consumption, the largest proportion of respondents (42.6%) preferred chewable forms, followed by liquid (33.0%), capsule (17.5%), and powder (6.9%). When asked about willingness to consume bamboo shoots as a health supplement, 41.9% were unsure, 28.2% agreed, 19.1% strongly agreed, 5.7% disagreed, and 2.4% strongly disagreed. A larger proportion expressed

willingness to buy such a supplement, with 41.6% strongly agreeing and 30.4% agreeing, while 22.0% were unsure and 5.9% disagreed or strongly disagreed. This gap between willingness to consume (47.3% agree/strongly agree) and willingness to buy (72.0% agree/strongly agree) suggests that purchase intention may be driven by factors other than personal willingness to consume, such as product availability, price, or perceived efficacy.

With respect to perceived outcomes, 34.2% reported that their health status much improved after consuming bamboo shoots, and 26.8% reported it improved, while 30.6% reported it very much improved. Regarding broader perceptions, 32.3% agreed and 30.9% strongly agreed that bamboo shoot supplements could improve the agriculture industry in rural areas; 34.2% agreed and 25.6% strongly agreed that bamboo shoots could be used in biomedicine; 31.8% agreed and 30.9% strongly agreed that bamboo shoots are currently only good as dishes, and 34.0% agreed and 25.6% strongly agreed that the body's nutrients need to be supplemented by bamboo shoots.

Pearson chi-square analyses demonstrated statistically significant associations ($p \leq 0.05$) between reasons for consuming bamboo shoots and all 17 awareness, usage, and perception variables examined, as summarised in Table 3. All associations remained significant after Bonferroni correction for multiple comparisons (adjusted $\alpha = 0.003$). However, effect sizes were generally small to weak, with Cramér's V values ranging from 0.06 to 0.16 for nominal variables and Spearman's rho values ranging from 0.019 to 0.090 for ordinal variables. This pattern indicates that, while the associations are statistically reliable, they are modest in magnitude. The most common response categories were "unsure" (for awareness of health properties, willingness to consume, and perceptions of agriculture industry, biomedicine, and dishes-only use), "very familiar" (for familiarity with bamboo shoots),

"never consumed" (for consumption experience), and "advertisement" (for information sources).

Discussion

Prior studies [24, 6] have proven that bamboo is beneficial as a source of antioxidants. Regular consumption of bamboo-based products may reduce the risk of age-related chronic diseases, including cardiovascular diseases, Alzheimer's disease, Parkinson's disease, cancer, and diabetes [6]. Specifically, bamboo shoots and leaves have commercial potential in the development initiative of functional foods [25] and nutraceuticals (medicinal or nutritionally functional foods). Green and organic awareness has gradually increased the concept of consumerism and put substantial demands on natural antioxidants, replacing the synthetic ones used in food and pharmaceutical supplies. The Institute for Public Health, Malaysian Ministry of Health, conducted the Malaysian Adult Nutrition Survey (MANS) in 2014, and it revealed the detailed quantitative information on nutritional status, food and nutrient intakes, and physical activity patterns on a nationwide sample of adult subjects between the ages of 18 and 59 years [27]. In this survey, food supplements are defined as non-vitamin and non-mineral supplement products with health claims that are made from natural food or food derivatives, for example, fish oil, the essence of chicken, sea cucumber products, and traditional herbs. The Institute for Public Health [27] defines traditional herbs as natural remedies derived from herbs and food, including botanical or animal-derived extracts. Therefore, the results of the Malaysian Adults Nutrition Survey (MANS) 2014 indicated that more Malaysians are taking food and mineral supplements for health reasons, especially among the urban population. It is also found that 30.9% of university students consume a dietary supplement [21], while adolescents consume 54.1% of vitamin and mineral supplements and 40.2% of food supplements. Based on the preceding scenarios, this paper sought to examine the

awareness, degree of utilisation, and perceptions of health supplements among Malaysians, especially regarding bamboo-derived health supplements and their potential in the nutraceutical sector.

Demographic characteristics and consumption patterns

There was insufficient statistical evidence found in this study to show an association between demographic characteristics and the reason why people consume bamboo shoots and take health supplements. This result indicates that, within this sample, the reasons respondents consumed bamboo shoots while also taking health supplements were not determined according to their demographic characteristics. Malaysians perceive bamboo shoots as traditional dishes without necessarily having scientific knowledge of their potential as health supplements. However, empirically investigating the factors influencing bamboo shoot consumption among different populations may become complex due to the different sociocultural environments [26, 19], particularly regarding perceptions and beliefs. Notably, respondents were strongly aware that they were consuming a nutritious bamboo shoot but were not sure what specific health properties (protein, carbohydrates, vitamins, and minerals) it contained. This pattern suggests a distinction between familiarity with a food as a culinary ingredient and familiarity with its nutritional composition — a gap that has practical implications for health education, since awareness of a food's general healthfulness does not necessarily translate into knowledge of its specific bioactive components or their mechanisms of action.

Respondents were also found to be aware of some varieties of bamboo, especially the *Gigantochloa* type. Additionally, most respondents claimed that ease of use (ready to cook) is an important factor in buying bamboo shoots, and most found related information (e.g., recipes, dish options) about bamboo shoots in advertisements. This pattern is

consistent with the finding that advertisements were the most common source of information about bamboo shoots (39.7%), ahead of the internet (27.8%) and personal recommendations (20.6%). It suggests that commercial messaging, rather than scientific or health communication, is currently the dominant channel through which Malaysians encounter information about bamboo shoots. If bamboo shoots are to be positioned as health supplements, this imbalance may need to be addressed through credible, evidence-based health communication that is not mediated solely by advertising.

Awareness and nutritional knowledge

It is worth acknowledging that Malaysians mostly recognise bamboo shoots as part of their local cuisine. This finding is a major indicator for researchers, inventors, producers, and marketers to build market awareness and educate the public about the nutritional composition of bamboo shoots, which contain large amounts of protein, fibre, vitamins, and minerals, as well as many nutraceutical compounds, including phenols and phytosterols. Scholars [5] contested that bamboo-based products and their food, with their nutritional and medicinal potential, remain unexploited and scarce. The bamboo shoots were found to retain a high source of protein, moderate fibre, and less fat content and were bestowed with essential amino acids, selenium, a potent antioxidant, and potassium, a healthy heart mineral [24, 5]. In essence, studies by Nirmala et al. [6] and Singhal et al. [5] have expedited further investigation to produce novel nutraceutical bamboo-based products that could provide benefits to society. In India and China, people have used bamboo shoots as food and traditional medicine, and in Malaysia, they are also part of local gastronomy. The empirical evidence presented in this paper provides avenues for future research to further explore the theoretical foundations, develop more rigorous survey instruments, and contribute additional conceptual insights. This research preliminarily assesses Malaysians' familiarity and awareness of bamboo

shoot consumption and their readiness to embrace health supplements derived from bamboo shoots. There are facets that demand enhanced clarification and substantiation in subsequent scientific and theoretical investigation in future study. These steps will improve the general understanding of Malaysian consumption behaviour and advance scientific investigation, specifically regarding the consumption of bamboo shoots from *Bambusa beecheyana*.

Willingness to consume and willingness to buy

A notable finding was the divergence between willingness to consume and willingness to buy. While 47.3% of respondents agreed or strongly agreed that they were willing to consume bamboo shoots as a health supplement, 72.0% agreed or strongly agreed that they were willing to buy such a supplement. One plausible explanation for this gap is that a substantial proportion of respondents (41.9%) were unsure whether they were willing to consume bamboo shoots as a health supplement. As one respondent pattern suggests, this scepticism may arise because such health supplements are not yet available on the market and therefore cannot be used as medical or product references. In the absence of a tangible product, consumers may express general purchase openness without committing to personal consumption. This distinction matters for commercialisation strategy: purchase intention may be a weaker predictor of actual adoption than personal willingness to consume.

Perception of health benefits and commercialisation potential

The finding that 45.2% of respondents believed bamboo shoots could cure gallbladder disorders and 49.0% believed they could prevent cancer warrants cautious interpretation. These beliefs exceed what current biomedical evidence supports. While bamboo shoots contain bioactive compounds with demonstrated antioxidant and anti-inflammatory properties [6, 24], claims of cancer prevention and gallbladder disorder treatment are not established in clinical literature.

The gap between public belief and scientific evidence suggests a need for evidence-based health communication to prevent overclaiming and to protect consumers from unrealistic expectations. It also raises the possibility that some respondents were expressing a generalised faith in natural remedies rather than specific knowledge of bamboo shoot pharmacology.

Regarding commercialisation potential, the pattern of associations suggests that the commercialisation of bamboo shoots as health supplements could consequently enhance the agricultural industry and increase the economic standing of people in rural areas, provided that production and marketing are developed responsibly. This aligns with prior observations that bamboo-based products remain under-exploited [5] and that functional food development offers economic as well as health benefits [7, 25]. However, this study observed small to weak effect sizes, and the sample was not nationally representative. The commercialisation potential suggested here is therefore provisional and should be tested through market research and feasibility studies before being treated as an established economic opportunity.

Methodological reflections

Several findings from this study warrant methodological caution in their interpretation. The extremely high Cronbach's alpha for the perception scale ($\alpha = 0.993$) suggests possible item redundancy rather than genuine unidimensionality; future studies should conduct factor analysis to determine whether the 11 perception items load onto a single factor or reflect multiple distinct constructs. Similarly, the small effect sizes across all 17 associations, while statistically significant after Bonferroni correction, indicate that the reasons for consuming bamboo shoots explain only a modest proportion of variance in awareness, usage, and perception. This finding is not unexpected in a cross-sectional survey of this kind, but it does mean that the practical significance of the

associations is limited and that other unmeasured factors (e.g., cultural background, prior exposure, health literacy) likely play larger roles.

Limitations

This study has several limitations that we should acknowledge:

1. **Geographic and ethnic skew:** The sample was heavily concentrated in Sarawak (70.1%) and among Malay respondents (60.3%), with Sabah (8.1%), Peninsular Malaysia (20.6%), the Federal Territory (1.2%), and non-Malay ethnic groups (Chinese 5.0%, Indian 1.2%, others 33.5%) under-represented relative to the national population. As bamboo shoot consumption varies substantially across Malaysian states and communities [1, 2, 26], the findings cannot be generalised to the national population. Future studies should employ stratified random sampling across all states and ethnic groups to ensure national representativeness.
2. **Age concentration:** Respondents aged 30 years and below comprised 77.2% of the sample, while those aged 41 and above comprised only 14.6%. Older adults, who may have different patterns of supplement use and traditional food consumption, were under-represented. Future research should purposively recruit older age groups.
3. **Non-probability sampling:** The use of purposive and snowball sampling introduces selection bias, as respondents were recruited through enumerators' networks and may share similar demographic and attitudinal characteristics. This limits the external validity of the findings.
4. **Self-report bias:** All data were collected via a self-administered questionnaire, which is susceptible to social desirability bias, recall bias, and misinterpretation of items, particularly regarding the health properties of bamboo shoots, with which many respondents were unfamiliar.
5. **Collapsing of response categories:** As described in the methods, the original seven response options for "reasons for consuming bamboo shoots" were collapsed into five analytical categories due to low response rates for options 5, 6, and 7 (crafts/art, medicine, and accessories). This collapsing may obscure distinctions among the original motivations, particularly medicinal and accessory uses, and limit the granularity of the findings.
6. **Cross-sectional design:** The cross-sectional design captures awareness, usage, and perception at a single point and cannot establish causality or track changes in perception over time.
7. **Instrument validation:** Content validity was assessed by two academicians and one chemistry expert. While the chemistry expert could assess the accuracy of statements about nutritional and bioactive properties, social science expertise in questionnaire design and health behaviour was limited. Future studies should include validation by social science and public health experts.
8. **Reliability of the perception scale:** The perception scale yielded an extremely high Cronbach's alpha ($\alpha = 0.993$), which may indicate item redundancy or multicollinearity rather than genuine internal consistency. This issue should be investigated in future studies through factor analysis.

Implications for policy and practice

The findings carry several implications. For health authorities, the gap between public belief in bamboo shoots' curative properties and the actual state of evidence suggests a need for balanced public health messaging that neither dismisses traditional food knowledge nor endorses unsupported therapeutic claims. For producers and marketers, the finding that advertisements are the dominant information channel indicates that commercial communication currently shapes public perception more than scientific communication

does; this situation creates both an opportunity (to inform consumers accurately) and a risk (of overclaiming). For researchers, the small effect sizes and the anomalous reliability coefficient point to the need for more refined instruments and larger, more representative samples. Finally, the finding that demographic characteristics were largely unrelated to consumption patterns suggests that bamboo shoot consumption in this sample is not strongly stratified by age, gender, income, or education — a finding that, if replicated nationally, would have implications for how health promotion is targeted.

Conclusion

This paper specifically demonstrates the Malaysians' current awareness, extent of usage, and perception of food supplements, particularly focusing on the bamboo shoots of *Bambusa beecheyana* as a health supplement. Despite the nutritional richness of *Bambusa beecheyana*, a properly risk-based GMP adherence in the production of health supplements is vital to enhance product safety and public health protection, as contested by the scholar [28]. To conclude, the results presented in this research indicate that Malaysians recognise the potential of bamboo shoots as a health supplement, which is informed by their understanding of the nutritional properties of bamboo shoots and their incorporation into Malaysian cuisine.

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Authors' contributions

Mian, V.J.Y. initiated and conceptualised the study. Rozaimie, A., handled the remaining writing of the manuscript.

Conflict of interest

The authors agree that this research was conducted in the absence of any self-benefits or commercial or financial conflicts, and they declare the absence of conflicting interests with the stakeholders (the authors, the university, and the public).

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Table 1a. Respondents' demographic profiles

<i>Demographic</i>	<i>n</i>	<i>%</i>	<i>Demographic</i>	<i>n</i>	<i>%</i>
Age			Monthly Income		
≤ 20	118	28.2	No income	213	51.0
21-30	205	49.0	RM1000 and below	125	29.9
31-40	34	8.1	RM1001-RM3999	35	8.4
≥ 41	61	14.6	RM4000-RM8500	42	10.0
<i>Total</i>	<i>418</i>	<i>100.0</i>	Above RM8500	3	0.7
			<i>Total</i>	<i>418</i>	<i>100.0</i>
Gender			Employment		
Male	210	50.2	Unemployed	30	7.2
Female	208	49.8	Employed	162	38.8
<i>Total</i>	<i>418</i>	<i>100.0</i>	Employed & part-time student	4	1.0
			Full-time student	210	50.2
Ethnicity			Retired	12	2.9
Malay	252	60.3	<i>Total</i>	<i>418</i>	<i>100.0</i>
Chinese	21	5.0			
Indian	5	1.2	Current Location		
Others (S&S native)	140	33.5	Sarawak	293	70.1
<i>Total</i>	<i>418</i>	<i>100.0</i>	Sabah	34	8.1
			Peninsular Malaysia	86	20.6
Highest Qualification			Federal territory	5	1.2
Primary school	4	1.0	<i>Total</i>	<i>418</i>	<i>100.0</i>
Secondary school	55	13.2			
Certificate	27	6.5	Are you currently consuming any health		
Diploma	143	34.2	supplements?		
Bachelor's degree	172	41.1	Yes.	161	38.5
Master's degree	11	2.6	No	257	61.5
Doctorate	4	1.0	<i>Total</i>	<i>418</i>	<i>100.0</i>
Professional certificate	2	0.5			
<i>Total</i>	<i>418</i>	<i>100.0</i>			

Table 1b. Summary of the Reliability of the Investigated Variables.

<i>Variables</i>	<i>No. of Item</i>	<i>Alpha (α)</i>	<i>Mean (μ)</i>	<i>Variance (σ²)</i>	<i>Standard deviation (σ)</i>
Reason for consuming health supplements	7	0.756	26.02	23.743	4.873
Awareness of the benefits of bamboo shoots	5	0.829	12.10	3.169	1.780
Usage/information about health supplements	2	0.822	25.05	33.519	5.790
Perception of bamboo shoots as a health supplement	11	0.993*	8.12	1.450	1.204

*Note: *The extremely high alpha (0.993) for the perception scale suggests possible item redundancy or multicollinearity. This should be investigated in future studies.*

Table 2. Frequencies of awareness, usage, and perception or belief about bamboo shoots as health supplements (n= 418).

	<i>n</i>	%		<i>n</i>	%
(Awareness)					
Reasons to consume bamboo shoots			Consume bamboo shoots?		
Stay healthy	17	4.1	Never	119	28.5
Medical recommendation	76	18.2	Seldom	60	14.4
Realising the nutrition in bamboo shoots	167	40.0	Unsure	66	15.8
Just as dishes	129	30.9	Often	93	22.2
Craft or art	29	6.9	Always	80	19.1
<i>Total</i>	<i>418</i>	<i>100.0</i>	<i>Total</i>	<i>418</i>	<i>100.0</i>
Familiar with bamboo shoots?			Familiar with a variety of bamboo		
Totally not familiar	53	12.7	Bambusa	53	12.7
Not familiar	20	4.8	Dendrocalamus	82	19.6
Unsure	73	17.5	Gigantochloa	139	33.3
Familiar	106	25.4	Melocanna	114	27.3
Very familiar	166	39.7	Phyllostachys	30	7.2
<i>Total</i>	<i>418</i>	<i>100.0</i>	<i>Total</i>	<i>418</i>	<i>100.0</i>
Are you aware of the health properties of bamboo shoots?					
Totally not aware	93	22.2			
Not aware	47	11.2			
Unsure	144	34.4			
Aware	83	19.9			
Highly aware	51	12.2			
<i>Total</i>	<i>418</i>	<i>100.0</i>			
(Usage)					
Important factor to buy bamboo shoots			Getting information about bamboo shoots		
Price	11	2.6	Newspaper or article	30	7.2
Ingredient	46	11.0	Recommendation	86	20.6
Nutrition facts	149	35.6	Advertisement	166	39.7
Easy to use	150	35.9	Internet	116	27.8
Taste	62	14.8	Social media	20	4.8
<i>Total</i>	<i>418</i>	<i>100.0</i>	<i>Total</i>	<i>418</i>	<i>100.0</i>
(Perception)					
Curing ability of bamboo shoots			Health remedy of bamboo shoots as a health supplement		
Asthma	73	17.5	Improve digestion	56	13.4
Coughs	77	18.4	Alleviate hypertension	68	16.3
Gallbladder Disorder	189	45.2	Prevent cancer	205	49.0
Influenza	65	15.6	Paralysis	66	15.8
3-series	14	3.3	Cardiovascular disease	23	5.5
<i>Total</i>	<i>418</i>	<i>100.0</i>	<i>Total</i>	<i>418</i>	<i>100.0</i>
Health benefits of bamboo shoots			Preferred form of bamboo shoots as a health supplement		
Hypolipidemic (cholesterol-lowering drugs)	22	5.3	Capsule	73	17.5
Prebiotic (non-digestible food ingredient)	67	16.0	Powder	29	6.9
Antibiotic (medicine)	172	41.1	Liquid	138	33.0
Astringent (for skin cells and other body tissues)	157	37.6	Chewable	178	42.6
<i>Total</i>	<i>418</i>	<i>100.0</i>	<i>Total</i>	<i>418</i>	<i>100.0</i>

	<i>n</i>	<i>%</i>		<i>n</i>	<i>%</i>
Willingness to consume bamboo shoots as health supplement			Willingness to buy bamboo shoots as a health supplement		
Strongly Disagree	10	2.4	Strongly Disagree	1	.2
Disagree	35	8.4	Disagree	24	5.7
Unsure	175	41.9	Unsure	92	22.0
Agree	118	28.2	Agree	127	30.4
Strongly Agree	80	19.1	Strongly Agree	174	41.6
<i>Total</i>	<i>418</i>	<i>100.0</i>	<i>Total</i>	<i>418</i>	<i>100.0</i>
Perceived health status after consuming bamboo shoots			Bamboo shoots as health supplements improve the agriculture industry in rural areas.		
No change	3	0.7	Strongly Disagree	4	1.0
Slightly better	32	7.7	Disagree	29	6.9
Improved	112	26.8	Unsure	121	28.9
Much improved	143	34.2	Agree	135	32.3
Very much improved	128	30.6	Strongly Agree	129	30.9
<i>Total</i>	<i>418</i>	<i>100.0</i>	<i>Total</i>	<i>418</i>	<i>100.0</i>
Bamboo shoots as a health supplement used in biomedicine			Bamboo shoots are only good as dishes.		
Strongly Disagree	6	1.4	Strongly Disagree	4	1.0
Disagree	27	6.5	Disagree	29	6.9
Unsure	135	32.3	Unsure	123	29.4
Agree	143	34.2	Agree	133	31.8
Strongly Agree	107	25.6	Strongly Agree	129	30.9
<i>Total</i>	<i>418</i>	<i>100.0</i>	<i>Total</i>	<i>418</i>	<i>100.0</i>
Nutrients for the body need to be supplemented by bamboo shoots.					
Strongly Disagree	7	1.7			
Disagree	29	6.9			
Unsure	133	31.8			
Agree	142	34.0			
Strongly Agree	107	25.6			
<i>Total</i>	<i>418</i>	<i>100.0</i>			

Note: Reasons for consuming bamboo shoots were originally presented with seven response options. Options 5 (crafts/art), 6 (medicine), and 7 (accessories) were selected by fewer than 5% of respondents each, producing expected cell counts below 5 and violating chi-square assumptions. These three options were collapsed into a single category ("Craft or art"), resulting in the five analytical categories reported here.

Table 3. Cross-tabulation analyses of reasons for consuming bamboo shoots and awareness, usage, perception variables

Association	χ^2	<i>p</i>	Effect Size	Magnitude	Modal Category	Modal % (<i>n</i>)
1. Reasons x Familiar with bamboo shoots	65.925	0.001	$\phi_c = 0.139$	Small	Very familiar	13.6 (57)
2. Reasons x Consume bamboo shoots	57.171	0.001	$\phi_c = 0.150$	Small	Never consumed	13.4 (56)
3. Reasons x Aware of health properties	117.828	0.001	$\phi_c = 0.131$	Small	Unsure	18.2 (76)
4. Reasons x Familiar with bamboo variety	108.326	0.001	$\phi_c = 0.160$	Small	<i>Gigantochloa</i>	16.7 (70)
5. Reasons x Important factor to buy	270.580	0.001	$\phi_c = 0.135$	Small	Easy to use	16.7 (70)
6. Reasons x Getting information	201.667	0.001	$\phi_c = 0.122$	Small	Advertisement	22.2 (93)
7. Reasons x Curing ability	173.630	0.001	$\phi_c = 0.130$	Small	Gallbladder disorder	24.4 (102)
8. Reasons x Health remedy	245.483	0.001	$\phi_c = 0.130$	Small	Prevent Cancer	27.0 (113)
9. Reasons x Health benefits	159.250	0.001	$\phi_c = 0.120$	Small	Antibiotic	22.7 (95)
10. Reasons x Preferred form	97.560	0.001	$\phi_c = 0.130$	Small	<i>Chewable</i>	25.6 (107)
11. Reasons x Willingness to consume	101.120	0.001	$\phi_c = 0.060$	Small	Unsure	21.1 (88)
12. Reasons x Willingness to buy	93.960	0.001	$\rho = 0.080$	Weak	Strongly agree	12.0 (50)
13. Reasons x Perceived health status	110.140	0.001	$\rho = 0.019$	Weak	Much improved	13.9 (58)
14. Reasons x Improve agriculture industry	93.960	0.001	$\rho = 0.070$	Weak	Unsure	16.3 (68)
15. Reasons x Use in biomedicine	77.280	0.001	$\rho = 0.088$	Weak	Unsure	16.5 (69)
16. Reasons x Only good as dishes	83.340	0.001	$\rho = 0.070$	Weak	Unsure	16.3 (68)
17. Reasons x Nutrients need supplementation	78.420	0.001	$\rho = 0.090$	Weak	Agree	13.6 (57)

Note 1: χ^2 = Pearson chi-square statistic. *p* = asymptotic significance (2-sided). ϕ_c = Cramér's *V* (reported for nominal variables). ρ = Spearman's rho (reported for ordinal variables).

Note 2: All associations remained statistically significant after Bonferroni correction for multiple comparisons (17 tests; adjusted $\alpha = 0.003$).

Note 3: Effect sizes are interpreted using conventional benchmarks: weak ($\phi_c/p < 0.10$), small ($\phi_c/p = 0.10-0.29$), medium ($\phi_c/p = 0.30-0.49$), large ($\phi_c/p \geq 0.50$).

Note 4: Reasons for consuming bamboo shoots. The reasons variable originally presented seven response options: (1) staying healthy, (2) medical recommendation, (3) realising the nutrition contained in bamboo shoots, (4) just as dishes, (5) crafts or art, (6) medicine, and (7) accessories. Options 5, 6, and 7 were selected by fewer than 5% of respondents each, producing expected cell counts below 5 and violating the chi-square test's assumptions. These three options were therefore collapsed into a single category ("Craft or art"), resulting in the five analytical categories used in this table: staying healthy, medical recommendation, realising the nutrition, just as dishes, and craft or art. The same collapsing procedure is described in the methods and in the footnote to Table 2.

Note 5: The "Modal Category" column identifies the response category with the highest observed count within each cross-tabulation. The "Modal % (*n*)" column reports the category's percentage of the total sample (*n* = 418) and its raw count. Modal values are descriptive indicators of the most common response pattern within each cross-tabulation and should not be interpreted as effect sizes or as measures of association strength.

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