AWARENESS OF BLACK GARLIC BENEFITS TO HEALTH: A PRELIMINARY STUDY

Neni Kartini Che Mohd Ramli[1*], Suriyati Ujang[2], Nazirah Ramli[2]

[1]*Faculty of Plantation and Agrotechnology,*
Universiti Teknologi MARA UiTM Pahang, 26400 Bandar Jengka

[2]*Faculty of Computer and Mathematical Sciences,*
Universiti Teknologi MARA UiTM Pahang, 26400 Bandar Jengka

[*]*Corresponding author: neni@uitm.edu.my*

Abstract

Black garlic is a beneficial and usable food product resulting from fresh garlic fermentation. It is used in Asian cuisine and is made by heating the whole bulb of garlic at a temperature of 60 – 90^{o}C and humidity of 70 - 90% over a period of several weeks. In Korea, black garlic is added to energy drinks as a health product and in Thailand it is claimed to increase human longevity. Black garlic has many health benefits such as able to reduce homocysteine levels in the bloodstream, improves blood circulation by boosting hydrogen sulphide production that can maintain stable blood pressure levels and support normal clotting. It can stimulate the activity of white blood cells in the immune system to fight infections. It is believed to be beneficial in normalizing blood sugar levels by enhancing insulin production. Black garlic can also increase the level of testosterone in both men and women indicating that it may be beneficial in boosting libido. Not much is known about the level of awareness in Malaysia concerning the health benefits of black garlic. Thus, this study was carried out to evaluate awareness regarding the health benefits of black garlic among academic staff in a higher learning institution in the East Coast of Malaysia. A questionnaire was constructed and then distributed via google form, and the data were analyzed using SPSS. The results showed that nearly three quarters of the respondents were aware of the black garlic's health benefits, but only a few consumed it.

Keyword: Black garlic, awareness, health benefits

Introduction

Garlic (*Allium sativum* L.), from the family of Alliaceae, is a common ingredient used as seasoning in Asian cuisine as well as in traditional and modern medicine (Butt, et al, 2009). It has been used in medicinal treatment since long time ago, including in ancient Egypt, India, Rome, China, Korea and Japan. Organosulfur compounds and bioactive enzymes are the key phytochemical compounds in garlic. Allicin is a well-known main component found in garlic and has various pharmacological effects, including anti-bacterial, anti-tumor, anti-hyperlipidemic and immunoregulatory activities (Ye & Zhang, 2003). Many findings show that garlic also has many health benefits such as antioxidant, antibiotic, anticancer, antihyperlipidemic, antidiabetic, anticoagulant, antimicrobial, anti-constipation, antiparasitic, diuretic and hepatoprotective effects (Khoo & Aziz, 2009; Shinkawa et al., 2009; Pal et al., 2006). In Vietnamese traditional medicine, Do (2004), stated that, garlic was able to treat amoebic and bacillary dysenteries, wound infection, hypertension, chronic bronchitis, whooping cough, and threadworm infection. Garlic was either used and consumed directly

(fresh garlic) or as a food processing and brewery product. The consumption and application of fresh garlic in foods and medicines are limited due to its characteristics of distinct odor, strong and spicy flavour, and a tendency to cause an upset stomach. There are numerous processed garlic products such as black garlic, smoked garlic, garlic oil, garlic oil macerate, garlic extract, garlic powder, supplement pill, garlic juice, alcoholic tincture and others. Black garlic is one of the most well-known functional food items on the Asian market, among all these processed garlic items. Black Garlic has been consumed for centuries in South Korea, Japan, and Thailand, and was introduced to Taiwan and other countries around 10 years ago. Bradley (2009) reported that Black Garlic, which has been used to flavour chicken, fish, soup, and risotto, has gained a great deal of attention from high-end chefs over the past few years.

Black garlic is produced via the process of fermentation. At high humidity and temperature, the whole bulb of fresh garlic is brewed, resulting in colour and taste changes. Garlic will turn black via a set of non-enzymatic browning reactions (**Figure 1**). This process of fermentation not only affects the physiochemical properties of garlic, but also increases the concentration of bioactive compounds (Kimura et al., 2017).

Figure 1 Black garlic

Black garlic has a traditional black colour, a sweet taste and a chewy texture without the unpleasant odour compared to the fresh garlic. Queiroz et al., (2009) stated that, after the fermentation process, black garlic produced a high content of polysaccharides, reducing sugar, protein, phenolic compounds, organic sulphur compounds and melanoidins. Choi et al. (2014) reported that, along with the fermentation process, the moisture content and pH of fresh garlic decreased, while the reduced sugar and total acidity accumulated. In contrast to fresh garlic, the colour spectrum and composition of amino acids in black garlic would also change. Black garlic, therefore, has an elastic and chewy texture and a sweet taste without the distinct taste of fresh garlic. Black garlic has the characteristic of organoleptic properties arising from its development process. The dark brown colour of black garlic was developed by non-enzymatic browning, and the pungent taste and odour of fresh garlic were removed by inhibiting the transformation of alliin into allicin as alliinase heat-inactivation (Montano, et al., 2004). In addition, as a result of heat treatment, the pH and moisture content decrease, which increases the shelf-life of the garlic (Chu et al., 2007).

The changes of physicochemical properties are the main factors for the enhanced bioactivity of black garlic compared to fresh garlic. The changes of physiochemical properties in black garlic compared to fresh garlic are shown in **Table 1**.

Table 1 Physicochemical properties of fresh and black garlic (Kimura, et al., 2017)

FRESH GARLIC	BLACK GARLIC
Lower in calories	Higher in calories
Higher in vitamin C	Lower in vitamin C
Less fibre & iron	More fibre and iron
More carbs	Less carbs
Higher in allicin (taste)	Lower in allicin
Lower in antioxidants	Higher in antioxidant

Fresh garlic contains about 63% of the water content, 28% of carbohydrate (fructans), 2.3% of organosulfur compounds, 2% of proteins (alliinase), 1.2% of free amino acids (arginine), and 1.5% of fibre (Santosha, et al., 2013). Toledano-Medina et al. (2016) stated that in whole black garlic bulbs, black garlic produces a polyphenol content three times higher than fresh garlic, and six times higher in peeled black garlic cloves, which is related with increased activity of antioxidants. In addition, the content of amino acids, carbohydrates, and S-allyl-L-cysteine in black garlic increased 2.5 times, 28.7 % - 47.0 %, and 8 times, respectively (Sasaki, et. al., 2017; Nai-feng, et. al. 2012).

The cloves of fresh garlic change their colour from white to brown during the fermentation process and eventually become black due to the Maillard reaction. At the same time, unstable compounds in fresh garlic are converted into stable, high antioxidant-power soluble compounds (Corzo-Martines, et. al., 2007; Imai, et.al., 1994). In addition, the organoleptic properties of black garlic are enhanced due to the decomposition of organosulfur compounds such as dialyl sulphide (DAS), dialyl disulfide (DADS), dialyl trisulfide (DATS), dithiins, and ajoene, and also the conversion of unstable and odorous compounds into stable and odourless compounds such as S-allyl-L-cysteine (SAC), (Amagase, 2006; Corzo-Martinez, 2007).

Black garlic contains much more functional compounds compared to fresh garlic, such as S-allyl-L-cysteine (SAC). SAC is a biologically active compound that have some biological activities such as antioxidant activity (Herrera-Mundo et al., 2006), anti-carcinogenic activity (Chu et al., 2007; Welch et al., 1992), anti-allergic, anti-diabetes, anti-inflammation and anti-hepatopathy activity (Chuah, et al., 2007) and can be used in nutraceutical and medical applications.

Black garlic has been reported for anti-cancer effect. Some studies have proposed that black garlic could be used to prevent and treat cancers from gastric cancer to leukaemia as a dietary product. Wang et al. (2011) proposed that dose-dependent aqueous black garlic extract could inhibit proliferation and cause apoptosis of a human gastric cancer cell line, SGC-7901 cells. The inhibitory effect of black garlic on tumour growth in tumour-bearing mice has also been observed.

Black garlic has also been reported to contain abundant antioxidant compounds from the fermentation reaction, including polyphenols, alkaloids, flavonoids, S-allyl-cysteine, and antioxidant intermediate products (Kimura et al., 2017; Choi et al., 2014). Recently, some studies have indicated that black garlic can be used to treat inflammation and septicaemia-related diseases as a prominent agent. Aqueous black garlic extract obstructs the manufacture of nitric oxide (NO) and proinflammatory cytokines, including tumour necrosis factor alpha (TNF alpha) and prostaglandin (PG)-E2, and suppresses the expression of NO synthase and TNF alpha and cyclooxygenase-2 by mechanism-related mitogen-activated protein kinase and nuclear factor-LPS-stimulated murine macrophages. Black garlic has been shown to protect the liver from side effects of cyclophosphamide, an anticancer medication, including hepatoxicity and apoptosis (Ahmed, 2018).

The advantages of traditional white garlic, a staple of day-to-day cooking, are well documented and known to most people. Black garlic, however, is widely underused and overlooked, perhaps due to lack of knowledge, despite some spectacular health benefits it offers. However, there is still a scarcity of studies examining the extent of understanding and information about the health benefits of black garlic. This research was therefore carried out to correct this deficiency and examine people's level of knowledge of the health benefits of black garlic.

Materials and Methods

A self-developed questionnaire consisting of questions that relate to the recipients' awareness of the black garlic's health benefits were distributed via online google form to academicians in a higher institution in the East Coast of Malaysia. As a preliminary study, 36 responses were collected. There are two parts in the questionnaire. The first section focuses on the respondents' demographic as well as their awareness on health supplements in general. Meanwhile, part B focuses on knowledge and participants' awareness specifically on black garlic as a health supplement. Fisher's Exact test was used since only a small sample size was involved in this study, in order to investigate academicians' tendency to take health supplement across age groups. The respondents were divided into two age groups namely, those not more than 44, and those more than 44 years old. The trend of usage among both groups is explained further based on the odd ratio of the values depicted on the bar chart. All analyses were conducted using SPSS version 24.

Result and Discussion

Demographic results revealed that about 11% of the respondents were male and 89% were female. As shown in Table 2, there were several reasons stated by the respondents with regards to the purpose of consuming health supplements in general. About 25% of the respondents said they did not need any health supplement. However, another 22.2% identified the action of taking health supplements as a means of prevention from diseases. 13.9% took them to aid recovery as part of their medical requirement while 8.3% of the respondents took the health supplement due to inadequate dietary intake. 19.4% said taking health supplements was a must to support the body's immune system. Meanwhile, only 8.3% and 2.8% of the respondents chose to take health supplements for the reasons of improving brain performance and aesthetic or beauty purpose respectively.

Table 2 The purpose of taking health supplement in general

	Percentage
Due to an inadequate diet	8.3
Support immune system	19.4
Medical requirement/to aid recovery	13.9
I don't need any health supplements	25.0
Improving brain performance	8.3
Prevention of diseases	22.2
Aesthetic/beauty reasons	2.8
Total	100.0

Based on Fisher's Exact test significant value which is 0.022 (less than 0.05), it can be concluded that age does affect the pattern of health supplement intake among academicians. The behaviour of those aged less than 44 years in taking health supplements differ from those

aged more than 44 years old.

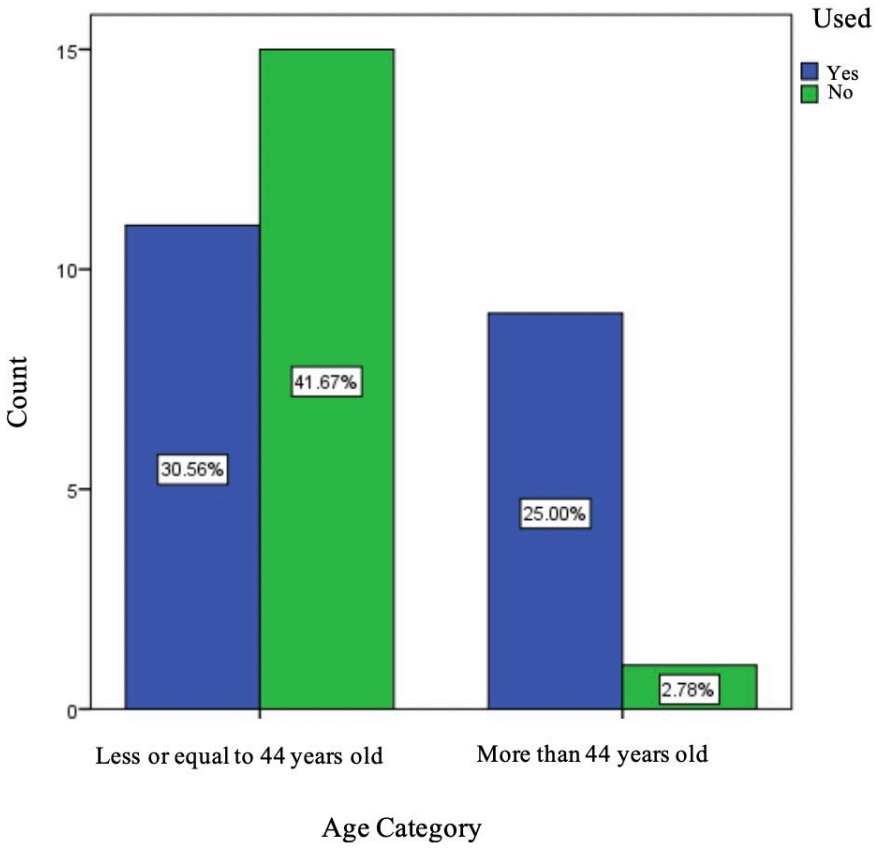

Figure 2 Bar chart of age vs consumption of health supplement

Results from **Figure 2** showed that, for the age category of less or equal to 44 years old, the percentage of those who never used or consumed any health supplement is higher. This is in contrast with those in the age group of more than 44 years old, where the possibility to consume health supplements is higher in this age group. This shows that the level of awareness on consuming health supplements is higher for those in the older age groups. Further analysis focuses on the respondents' knowledge of the black garlic and its benefits. Results show that only about 66.7% had heard about black garlic. Meanwhile 25% had not heard about it and the remaining 8.3% were not sure. For the respondents who had heard about the black garlic, their source of knowledge was through friends and internet. However, even though 66.7% respondents had previously heard about the black garlic, only 11.1% had consumed it as a health supplement. Results also showed that, most respondents consumed black garlic for the purposes of avoiding heart disease, reducing blood pressure and lowering blood cholesterol level.

Conclusion

From this preliminary study, it can be concluded that most people acknowledge that they need to take health supplements although their reasons for taking them differ. Most take health supplements for the perceived health benefits especially to ward off diseases and aid recovery from ailments. The need to take health supplement increases as they age. In addition, among those who are aware of the benefits of black garlic, only a small number actually consume it. This certainly warrants further research especially on the reasons for the lack of enthusiasm for this highly beneficial product. Considering the increase in the country's older population, as well as increased awareness in wellness issues among the

general population, the potential for commercialization of the black garlic is great. Thus, more research relating to interest in and potential consumption of the black garlic among various members of the public is hugely important. Furthermore, the numerous benefits of black garlic need to be disseminated through the media, talks and conferences to reach those who can benefit the most from taking them.

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Conflict of interests

Authors hereby declare that there is no conflict of interest with any organization or financial body supporting this research.

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