TEST Engineering & Management

November-December 2019
ISSN: 0193-4120 Page No. 3339 - 3344

Examination of Chili Paste and Black Bilimbi Sambal from SMEs' (Small Medium Enterprise) in Ascertaining Safe Consumption

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Article Info
Volume 81
Page Number: 3339 - 3344
Publication Issue:
November-December 2019

Article History
Article Received: *5 March 2019*
Revised: *18 May 2019*
Accepted: *24 September 2019*
Publication: *16 December 2019*

Abstract:
Chili Paste and Black Bilimbi Sambal are Malaysian traditional foods. The purpose of this preliminary study is to analyze the presence of bacteria in the randomly selected local chilli paste and Black bilimbi sambal products. The samples were taken through simple random sampling from small medium enterprises village industry that manufactured the chili paste and black bilimbi spicy paste. The sample were analyzed in ascertain the safe consumption of those food. The analysis was done through the Viable Plate Count Method or also known as Total Plate Count that was certified by the MARDI (Malaysian Agricultural Research and Development Institute). The microbiology growth was determined by counting the bacteria colony growth of the food sample and the unit is CFU/g. The laboratory result of bacteria colonies for chili paste was <1.0 x101 CFU/g while the black bilimbi sambal was 3x101 CFU/g. This result revealed that "chili giling" and black bilimbi sambal are safe to consume. The results is under permitted level stated by the Food and Drug Administration (FDA) which is 101 respectively.

Keywords: *Averrhoa bilimbi, Black bilimbi sambal, capsicum frustacean Linn, Chili Paste*

I. INTRODUCTION

Chili paste also known as "chili giling" is a popular, easy-to-use food that normally consumed by people globally. However, there is a limited study on the microbiological status of chili paste. Chili either in the form of fresh or dried is widely used in enhancing food properties due to their hotness and pungent odour. In Malaysia, chili paste produced from fresh or dried chili is a convenient, consumable and easy-to-use food ingredient [1][2]. Production and processing of chili paste involve blending the chili together with filter water, salt, and organic acid as a preservative. Sometimes, the puree undergone evaporation in a steam-jacketed kettle before packaging in order to make the puree more concentrated or to minimize the moisture content in the puree [3].

Chili paste was widely consumed by Malaysian, however few studies of its microbiological contamination. The previous study done by [3] revealed that the quality of chili paste in the market was not standardized due to the different level of pH, moisture content, and total soluble solids. Even though dried chili is the main raw material and it is less exposed to the bacteria growth because of its dryness, food microbiological contamination might

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occur during processing or during manufacturing that is before and after the finish product.

Black Bilimbi Sambal is a ready-to-eat food and was announced as Pahang traditional food with the name "Sambal Pahang" by Tengku Puan Pahang, Tunku Azizah Aminah Maimunah Iskandariah on 11 November 2013 [4]. Nowadays, a market the demand for Black Bilimbi Sambal was increasing dynamically that the manufacturer or producer need to take initiative seriously in maintaining its sources. In line with that, there was a report that tree sorrel planting campaign has been done tremendously in Peninsular Malaysia by Malaysia Federal Agricultural Marketing Authority (FAMA) [5].

According to Komeng in [6] the ingredients in preparing this sambal is bilimbi fruit, paddy chili, anchovies, onions, garlic, oil, soy sauce, salt, and sugar. Steps in preparing the food are as follows: firstly, the bilimbi need to wash cleanly and boiled it without water up to 3 hours until it turns black color, then, chili, anchovies, and onions were chopped together before fried them. Lastly, salt, sugar and soy sauce were added and keep stir it until they were well mix together. It has three taste, the taste is spicy, sour and sweet that could make people addicted to it [7]. Black Bilimbi Sambal is good in generating appetite and delicious when eating together with rice.

Although this traditional food becomes more popular nowadays, the lack of food safety of this sample has been studied. Consequently, this study aimed to analyze the ascertaining of safe consumption of chili paste (chili Giling) and black bilimbi sambal through food microbiological analysis as the preliminary data.

II. Literature Review

A. *Food Microbiology and Food Safety*

Microorganisms could growth in many types of food because they are everywhere and could survive in any environmental conditions. Food microbiology can be defined as the study of microorganisms that could spoil the food. Food microbiology is also a subset of food safety which must focus more on the most important factor determines the safeness of food. Fewer concerns about food microbiology may lead to the microbial foodborne illness. This microbial foodborne illness comes from food intoxication and food infection which could give a harmful effect to the human when eating the food [8, 9].

According to Industries in [10], food microbiology could be measure by predicting the growth of microorganism such as bacteria, mold, and virus on food. These types of microorganisms could grow in aerobic or microaerophilic condition. The growth of microorganism could be detected by identifying the characteristics of food that could help the micro-living things growth on food, using computer-based microbiological models and perform the laboratory test. The most common method use is laboratory analysis which inoculates the food with certain concentration and observes the growth rate of the bacteria. There are six factors that may lead to the growth of the microorganism on food which are nutrient requirements, acidity, time, temperature, oxygen, and moisture [9].

B. *Dried Chilli (Capsicum Spp.)*

Chilli is the main spice vegetable under genus Capsicum and member of family Solanaceae normally crop cultivated in tropical and subtropical regions in the world [11]. The combination of its nutritional value, colour, flavour, and taste make people around the world love consume this vegetable [12]. According to [13] dried powder or fine flakes of chili is mostly consumed by people. In order to control market price due to an overflow of fresh chili in the market, the preservation of chili through drying chili was introduced [14]. The Sun drying method is the most conventional used rather than hot air and freezes dried to reduce moisture content in fresh chili, but it depends on the sunlight, temperature and air humidity received [15]. Thus, the sensory profiles which are hotness and the pungent odour of dried chili might vary from the fresh chili.

The main biologically active compounds found in the Capsicum spp. are flavonoids, phenols, carotenoids, capsaicinoids and vitamins [16]. [1] Mentioned that the component enhances the spicy the flavour of chili is capsaicinoids with the main compounds are capsaicin and dihydrocapsaicin. Based on the study done by [17], capsaicinoids have shown it was the agent for antimicrobials, anti-inflammatories, and anticarcinogens. Pepper

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polyphenols and capsaicinoids (coumarin, caffeic acid, naringin, kaempferol, rutin, quercetin, capsaicin, and dihydrocapsaicin) were tested its antimicrobial activity, a combination of kaempferol, quercetin and caffeic acid shown great resistance against bacteria [18].

C. *Red/Green Chilli (Capsicum frustecens Linn)*

Capsicum frustecens Linn is a red or green chili pepper that normally consume by the human under family Solanaceae. C. frustecens L. is known as paddy chili or bird's eye chili. Pugliese et al., in [19] stated that chili pepper is broadly used as a colorant, adding spicy taste and flavouring agent to food. Based on the study done by Krzyzanowska, Czubacka, & Oleszek in [20] chili contains phytochemicals such as flavonoids, capsaicinoids, and phenols that rich in antioxidant. Besides that, (Otunola et al., in [21] added the information of its chemicals continent by reporting that C. frustecens have essential minerals such as zinc, iron, magnesium, potassium, and phosphorus.

Study of antibacterial properties done by Bello, Boboye, & Akinyosoye in [22] mentioned that C. frustecens has antibacterial properties against Salmonella typhi, Escherichia coli, Pseudomonas aeruginosa, Serratia marcescens, Staphylococcus aureus, Enterococcus aerogenes, and Proteus vulgaris. Thus, C. frustecens may have potential as an antimicrobial agent and maybe use as preservative agents as well.

D. *Tree Sorrel (Averrhoa bilimbi)*

Averrhoa bilimbi is a native plant of the West Malaysia and originated in Southeast Asia. Bilimbi, cucumber tree, tree sorrel, and pickle tree are the common names of A. bilimbi. In Malaysia, it is called "Belimbing Buluh", Belimbing Besi or Belimbing Asam". Moreover, based on [23] this tree is categorized as an underutilized fruit, widely cultivated in Malaysia and commonly consumed by Malaysian. Based on the previous study done by [24], there were 53 different components were identified as the volatile constituents and [25] also reported that *A. bilimbi* is rich with vitamin C and oxalic acid. Therefore, the studies have shown that *A. bilimbi* is in acidic value.

In addition, bilimbi fruit also showed a positive antibacterial activity against several Gram-positive bacteria and Gram-negative bacteria such as Staphylococcus aureus, Bacillus cereus and Salmonella typhi [26]. In a recent study by [27], antimicrobial properties of bilimbi fruit were varying at maturity stages and early stage of maturity have high antimicrobial activity against Gram-positive (Staphylococcus aureus, Bacillus cereus), Gram-negative (Pseudomonas aeruginosa, E. coli and Salmonella spp.).

III. METHODOLOGY

Two samples of Dried Chilli Paste and black bilimbi sambal each were randomly collected from SMEs. Each of the samples at 200 g in weight with different expiry date were sampled. The procedure from the Food and Drug Administration (FDA) of Bacteriological Analytical Manual: Total Plate Count was referred for determining the microbiological status of samples. Firstly, five decimals dilutions of the samples; 10-1, 10-2, 10-3, 10-4 and 10-5 were prepared. The dilutions were diluted by using Butterfield's phosphate-buffered water as the solvent for the Dried Chilli Paste (solute) and black bilimbi sambal. The step was carried out by drawn out 1 mL suspension from homogenized samples by using a sterile pipette. Then, all the dilutions need to shake for 25 times within 7 seconds for totally mix the sample with solvent. Petri dishes filled with 12-15 mL plate count agar were prepared as the site for bacteria growth. Then, 0.1 mL homogenate aliquots from each dilution were pipetted and spread on plate count agar.

The mixture of agar and water filled in the petri dish has become the control for each series of samples. The sterile bent glass rod was used during a spreading process of the dilution on the agar. Alternate rotation and back-and-forth motion of plates on the flat level surface was applied in order to mix the sample dilution and agar medium thoroughly and evenly. Then, wrapped the petri dish with plastic paraffin film and let the agar to solidify. All the Petri dishes were incubated hours at 35oC for 48 hours. Growth of the microorganism was observed and counted with normal plates ranges from 25 to 250 colonies. Colonies found a unit (CFU) as the unit for bacteria growth colonies calculated using the formula below:

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$$N = \frac{\Sigma^{C}}{[(1 \times n_1) + (0.1 \times n_2) \times (d)]}$$

Where:

N = Number of colonies per ml or g of product

∑C = Sum of all colonies on all plates counted

n1 = Number of plates in the first dilution counted

n2 = Number of plates in the second dilution

d = Dilution from which the first counts were obtained

IV. Result and Discussion

Table 1 shows the Total Plate Count of Dried Chilli Paste from the selected premise. Both of the samples have the same CFU reading which is less than 1.0 x 10^1 CFU/g. Both of the samples were good to consume and under maximum level permitted by FDA which is 10^3 CFU/g for easy-to-eat food category. CFU/g reflected the growth of microorganism which influenced by several factors such as present of preservative or antimicrobial component and hygienic process during food production.

The less reading value of the CFU/g reading was due to its moisture content, acidic value, preservative content and antimicrobial deposited in the chili. Fresh or dried chili of chili paste should not less than 15% moisture content in order to comply with the Malaysian Food Act 1983 and Food regulation 1985. Based on the previous study, most of the chilli paste have acidic pH range between 3.58 and 5.13 [3]. Moreover, the presence of the benzoic acid as the permitted preservative have effect in lowering the pH value below 5.0 [28]. In addition, the antimicrobial agent naturally found in the chili and hygiene practices throughout the production line could help in lowering the colonies of bacteria [3].

Table 1: Result of Total Plate Count of "Cili Giling"

Sample Reference Number	Description	Total Plate Count (CFU/g)
M123/17 (E)	Cili Giling (A)	< 1 x 10^1
M124/17 (E)	Cili Giling (B)	< 1x 10^1

Source: MARDI test certificate 23/11/2017

There were 2 samples of the Black Bilimbi Sambal that have been tested. Table 2 shows that both of the samples were under acceptance level permitted by FDA which were 1.5 x 10^1 and 4.5 x 10^1 respectively. The mean of the samples is 3.0 x 10^1 which still under acceptance level of FDA. The permitted level for ready-to-eat food stated by FDA is below than 10^2.

The data collected shown that Black Bilimbi Sambal is safe to consume. As mentioned earlier in the literature review, both of the main ingredients of the samples bilimbi fruit and chili pepper has an ability in inhibiting the growth of the bacteria. Bilimbi fruit as the important ingredient rich in oxalic acid which is 3 pH value is the best factor for antimicrobial agent [27]. Plus, according to the Zakaria in [26], the longer the boiling time of the Bilimbi fruit during processing, will prolong the shelf life of the Black Bilimbi Sambal.

Nevertheless, *C. frustecens* can inhibit the growth of bacteria due to its bioactive compositions such as tannins, saponins and flavonoids that were capable in coagulating the wall proteins of bacteria and inhibit the activity of an enzyme by disrupting microbial membrane of microorganisms [29].

Table 2: Result of Total Plate Count of "Sambal Belimbing Hitam"

Sample Reference Number	Description	Total Plate Count (CFU/g)
U1958/17	A1 (Sambal Belimbing Hitam)	1.5 x 10^1
U1961/17	A4 (Sambal Belimbing Hitam)	4.5 x 10^1

Source: MARDI test certificate 09/08/2017

V. Conclusion

As the preliminary study, the conclusion that can be made is Chili paste and Black Bilimbi Sambal are safe to consume due to its lower CFU/g. The bacterial count via Total Plate Count Method

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presented a satisfactory range of microbiological data according to the regulatory standard (FDA). As a suggestion, in order to ensure the food quality and safety data, the study of nutritional value and microbiological study during production and finish product should be done. Thus, the findings of this study recommend that Chili paste and Black Bilimbi Sambal should be studied regularly from many samples to further improve its food microbiology in order to get the food safety data before commercializing globally.

ACKNOWLEDGMENT

The authors would like to thank Malaysian Agricultural Research and Development Institute (MARDI) for their support and Innovation and Research Management Centre (iRMC), Universiti Tenaga Nasional (UNITEN), and for giving permission to publish this paper.

REFERENCES

[1] Barbero, Gerardo F., Aurora G. Ruiz, Ali Liazid, Miguel Palma, Jesús C. Vera, and Carmelo G. Barroso. "Evolution of total and individual capsaicinoids in peppers during ripening of the Cayenne pepper plant (Capsicum annuum L.)." *Food chemistry* 153 (2014): 200-206. Available online: https://www.sciencedirect.com/science/article/pii/S0308814613019365.

[2] Laohavechvanich, P., K. Kangsadalampai, N. Tirawanchai, and A. J. Ketterman. "Effect of different Thai traditional processing of various hot chili peppers on urethane-induced somatic mutation and recombination in Drosophila melanogaster: Assessment of the role of glutathione transferase activity." *Food and chemical toxicology* 44, no. 8 (2006): 1348-1354. Available online: https://www.sciencedirect.com/science/article/pii/S0278691506000470.

[3] Zaini, Nurul Aqilah Mohd, Hanis Hazeera Harith, Akanbi Taiwo Olusesan, Anwarul Hidayah Zulkifli, Fatimah Abu Bakar, Azizah Osman, Azizah Abd Hamid, and Nazamid Saari. "Level of chemical and microbiological contaminations in chili bo (paste)." *Journal of food protection* 73, no. 3 (2010): 541-546. Available online: http://www.jfoodprotection.org/doi/abs/10.4315/0362-028X-73.3.541.

[4] Unkwon author, "Sambal Belimbing Hitam Kini Sambal Pahang", article from Utusan Malaysia Newspaper published on 12 November (2013). Available online: http://ww1.utusan.com.my/utusan/Pahang/20131112/wp_04/Sambal-belimbing-hitam-kini-Sambal-Pahang.

[5] Mohd. Rafi Mamat, "Sumber Sambal Hitam", article from Harian Metro Newspaper publishe on 16 October (2015). Available online: https://www.hmetro.com.my/mutakhir/2015/10/85551/sumber-sambal-hitam.

[6] Komeng. "Sambal Hitam Pahang Jadi Rebutan di Terengganu" (2017), article from http://malaysianewstodays.blogspot.my/2017/06/sambal-hitam-pahang-jadi-rebutan-di.html.

[7] Zakaria, M. (2013, May). Keenakan "sambal hitam" tradisional 9. Available online: http://www.sinarharian.com.my/karya/keenakan-sambal-hitam-tradisional-1.158589.

[8] Húngaro, H. M., Peña, W. E. L., Silva, N. B. M., Carvalho, R. V, Alvarenga, V. O., & Sant'Ana, A.S. Food Microbiology in Van Alfen, Neal K. Encyclopedia of agriculture and food systems. Elsevier, (2014), pp: 213-231.

[9] USDA. (2012). Introduction to the Microbiology of Food Processing. Food Safety and Inspection Service, (August), 1–64.

[10] Ministry for Primary Industries, of New Zealand Government (2016). Guidance Document How to Determine the Shelf Life of Food, (June).

[11] Dimitrios, Boskou. "Sources of natural phenolic antioxidants." Trends in Food Science & Technology 17, no. 9 (2006): 505-512. Available online: https://www.sciencedirect.com/science/article/pii/S0924224406001427.

[12] Dubey, Rakesh Kr, Vikas Singh, Garima Upadhyay, A. K. Pandey, and Dhan Prakash. "Assessment of phytochemical composition and antioxidant potential in some indigenous chili genotypes from North East India." *Food Chemistry* 188 (2015): 119-125. Available online:https://www.sciencedirect.com/science/article/pii/S030881461500342.

[13] Turhan, Mahir, K. Nazan Turhan, and Ferhunde Sahbaz. "Drying kinetics of red pepper." *Journal of Food Processing and Preservation* 21, no. 3 (1997): 209-223. Available online: https://onlinelibrary.wiley.com/doi/abs/10.1111/j.17454549.1997.tb00777.x.

[14] Charmongkolpradit, Suparerk, Kittichai Triratanasirichai, and Narong Srihajong. "Drying characteristics of chili using continuous fluidized-bed dryer." *American*

November-December 2019
ISSN: 0193-4120 Page No. 3339 - 3344

Journal of Applied Sciences 7, no. 10 (2010): 1300-1304. Available online: https://www.cabdirect.org/cabdirect/abstract/20113251693.

[15] Toontom, N., W. Posri, S. Lertsiri, and M. Meenune. "Effect of drying methods on Thai dried chilli's hotness and pungent odour characteristics and consumer liking." *International Food Research Journal* 23, no. 1 (2016): 289-299. Available online: http://www.ifrj.upm.edu.my/23%20%2801%29%202016/%2843%29.pdf.

[16] Rosa, Antonella, Monica Deiana, Viviana Casu, Stefania Paccagnini, Giovanni Appendino, Mauro Ballero, and M. Assunta Dessí. "Antioxidant activity of capsinoids." *Journal of Agricultural and Food Chemistry* 50, no. 25 (2002): 7396-7401. Available online: https://pubs.acs.org/doi/abs/10.1021/jf020431w.

[17] Reilly, Christopher A., Dennis J. Crouch, Garold S. Yost, and Alim A. Fatah. "Determination of capsaicin, dihydrocapsaicin, and nonivamide in self-defense weapons by liquid chromatography-mass spectrometry and liquid chromatography-tandem mass spectrometry." *Journal of Chromatography A* 912, no. 2 (2001): 259-267. Available online: https://www.sciencedirect.com/science/article/pii/S002196730100574X.

[18] Mokhtar, Meriem, Giovanna Ginestra, Fatma Youcefi, Angela Filocamo, Carlo Bisignano, and Ali Riazi. "Antimicrobial Activity of Selected Polyphenols and Capsaicinoids Identified in Pepper (Capsicum annuum L.) and Their Possible Mode of Interaction." *Current microbiology* 74, no. 11 (2017): 1253-1260. Available online: https://link.springer.com/article/10.1007/s00284-017-1310-2.

[19] Pugliese, Alessandro, Monica Rosa Loizzo, Rosa Tundis, Yvonne O'Callaghan, Karen Galvin, Francesco Menichini, and Nora O'Brien. "The effect of domestic processing on the content and bioaccessibility of carotenoids from chili peppers (Capsicum species)." Food chemistry 141, no. 3 (2013): 2606-2613. Available online:https://www.sciencedirect.com/science/article/pii/S0308814613006298.

[20] Krzyzanowska, J., Czubacka, A., & Oleszek, W. (2010). Dietary phytochemicals and human health. In Bio-Farms for Nutraceuticals (pp. 74-98). Springer, Boston, MA.

[21] Otunola GA, Oloyede OB, Oladiji AT, Afolayan JA (2010). Comparative analysis of the chemical composition of three Spices- Allium sativum L., Zingiber officinale, Rosc. and Capsicum frutescens L. commonly consumed in Nigeria. Afr. J. Biotechnol. 9(41): 6927-6931.

[22] Bello, I., Boboye, B. E., & Akinyosoye, F. A. (2015). Phytochemical screening and antibacterial properties of selected Nigerian long pepper (Capsicum frutescens) fruits. *African Journal of Microbiology Research*, *9*(38), 2067–2078. https://doi.org/10.5897/AJMR2014.7286.

[23] Yan, S. W., Ramasamy, R., Alitheen, N. B. M., & Rahmat, A. (2013). A comparative assessment of nutritional composition, total phenolic, total flavonoid, antioxidant capacity, and antioxidant vitamins of two types of malaysian underutilized fruits (Averrhoa bilimbi and Averrhoa carambola). *International Journal of Food Properties*, *16*(6), 1231–1244. https://doi.org/10.1080/10942912.2011.582975.

[24] Wong, K. C., & Wong, S. N. (1995). Volatile constituents of Averrhoa bilimbi L. fruit. Journal of Essential Oil Research, 7(6), 691-693.

[25] Hasanuzzaman M, Ali MR, Hossain M, Kuri S, Islam MS. Evaluation of total phenolic content, free radical scavenging activity and phytochemical screening of different extracts of Averrhoa bilimbi (fruits). Int Curr Pharm J (2013);2:92-6

[26] Zakaria ZA, Zaiton H, Henie EF, Jais AM, Zainuddin EN.In vitro antibacterial activity of Averrhoa bilimbi L. leaves and fruits extracts. Int J Trop Med (2007);2:96-100.

[27] Aziz, S. I. M. and N. A. A. (2016). Journal of Medical Microbiology & Antimicrobial Properties of Averrhoa bilimbi Extracts at Different Maturity Stages, 5(3), 10–12. https://doi.org/10.4172/2161-0703.1000233.

[28] Chipley, John R. "Sodium benzoate and benzoic acid." *Food Science and Technology-New York-Marcel Dekker*- 145 (2005): 11. In P. M. Davidson, J.N. Sofos, and A. L. Branen (ed.), Antimicrobials in food, 3rd ed. Taylor & Francis, Oxford.

[29] Olajuyigbe OO, Afolayan AT (2012). Antimicrobial potency of the ethanolic crude bark extract of Ziziphus mucrorata Subsp. mucronata willd. Afr. J. Pharm. Pharmacol. 6(10):724-730.