

Market Study of Soy Sauces in Cambodia

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Abstract: Soy sauce is a liquid condiment originated from China and is widely used not only in China, but also in Asia including Cambodia. Although some soy sauces have been produced in Cambodia, their quality has not yet been widely recognized in Cambodia and the study of soy sauces in Cambodia is still limited. The objective of this survey aimed to collect information about the current status on soy sauce consumption in Cambodia, for future research and development of Cambodian soy sauce. Survey's participants were selected from the age of 11 years old and up. Each participant was asked to answer all 12 questions before submitting their answers. As a result, among 655 respondents, the average of household size was 4.49 people. Approximately 53.4% of participants consume less than one bottle per month with their family and 41.9% of consumers used soy sauce between one and three bottles of soy sauce with the daily consumption in this group being about 4.6 mL per day. Salty-sweet soy sauce is the most preferable taste followed by the slightly salty taste. The volumes of the their favorite soy sauce bottle were 450 mL, 500mL and 250 mL. Out of 50 soy sauce brands, the soy sauces that had the code C2 (Cambodia's soy sauce), V3 (Vietnam's soy sauce), TH5 and TH3 (Thailand's soy sauce), are the brands that many respondents in the survey have used, and 83.80% of respondents have consumed the soy sauce that costs between 2500 riels and 7900 riels. In conclusion, the soy sauce brands (C2, V3, TH5 and TH3) are the brands that are consumed by most of the respondents. Among them, TH5 has higher quality by comparing with the Cambodian soy sauce standard. Salty sweet taste is the favorite taste by the respondents.

Keywords: Soy sauce; Survey; Cambodia; Brand; Taste

1. INTRODUCTION

Soy sauce has been a liquid condiment originated from China since approximately 2200 years ago. It is produced by mixing the steamed soybeans with roasted and grided wheat, and Koji mold spores and incubate for 3 to 5 days followed by fermentation in brine for about 3 to 6 months (Leboffe and Pierce, 2006). People in Asian countries such as China, Japan, Korea, Thailand, the Philippines, Indonesia, and more than 90% of Cambodian people consumed soy sauce (Theary et al., 2013). Soy sauce is normally used in cooking, such as in soups, frying, roasting, marinating, and also for dipping. It is widely used in the purpose of food, for improving the taste, flavor and aroma, as it is the main source of natural umami taste (Marcus, 2019). Not only that, scientists found that soy sauce also contains bioactive compounds with anticarcinogenic, antimicrobial,

antioxidative, and antiplatelet activities (Murooka and Yamshita, 2008) and also antiallergenic activity (Kobayashi, 2005). The soy sauce consumption and variety in Cambodia is unknown. Moreover, the quality and safety of the soy sauces has limited study. The objective of this market study of soy sauces in Cambodia was to collect information on the current status on soy sauce consumption in Cambodia for future research and development of Cambodian fermented soy sauce.

2. METHODOLOGY

2.1 Survey

The online survey was conducted from 01 February 2020 until 15 June 2020 (using Google forms). Aiming on participants whose age are from 11 years old and up. The survey link was sent through Facebook, e-mail, asking consumers directly, or by telephone calls for collecting the data of current status on soy sauce consumption in

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Cambodia. There were 12 questions containing in survey including three open-ended and nine close-ended questions: 1. Sex, 2. Occupation, 3. Age, 4. Frequency of using soy sauce, 5. Favorite taste, for knowing which taste that Cambodian people like to eat, 6. which brand of soy sauce that they like, production's country and reason of their preference, 7. Family members that they are living with, 8. Volume of soy sauce per bottle that they use, 9. How many bottles of soy sauce they buy per month, 10. Purchasing location, 11. Price of soy sauce, and 12. Their support on future soy sauce product with the good quality and safety for consumer.

2.2. Data analysis

Survey data were exported from online survey Google form to an excel file, then data in excel file were transferred to the statistical Package for Social Science (SPSS) Version 20.0 (SPSS Inc., Chicago, IL, USA). Descriptive statistic are reported for all variables such as calculate the percentage, validate the percentage. Pearson chi-square test was used to evaluate associations between categorical variables. Differences were considered statistically significant for $p < 0.05$. OriginPro was used for drawing Pie diagrams (Version 2018, OriginPro Inc.). Average daily soy sauce consumption was calculated by dividing the total volume of soy sauce used per month in the household with the total members within 30 days.

2.3. Physicochemical analysis of soy sauces

The favorite soy sauce brands used by respondents were bought from the markets to analyze their physicochemical characteristics. The salt concentration was analyzed by using salt-meter (Atago model ES-421), pH measurement was analysed by using pH meter (OHAUS, Starter300), soluble salt free solid content was analysed by following the method as described in (GB/T, 18186-2000), amino nitrogen was analysed as described in (GB/T, 18186-2000), and total nitrogen was analysed as described in (AOAC, 991.20). The soy sauce samples were analysed in triplicate and data was represented in the form of mean \pm standard deviation (SD). Analysis of variance (ANOVA) with Tukey's test was performed to evaluate significant difference in the physicochemical parameters from different samples, and a significant difference was defined as $p < 0.05$, and one-way ANOVA was conducted using SPSS software.

3. RESULTS AND DISCUSSION

In the survey of 655 people, 64.4% were female and 35.6% were male. Participants were mostly in the age between 18 to 49 years old (Table 1).

Table 1. Age of the respondents

Age	Participants	Percentage (%)
11 – 17	8	1.2
18 – 29	496	75.7
30 – 49	130	19.8
50 – 64	13	2.0
65+	8	1.2
Total	655	100

According to the survey data as shown in Fig. 1, the consumption of soy sauce in Cambodia varied. 38.8% of respondents consumed soy sauce 2 or 3 times per week, and 27.2% of respondents consumed soy sauce 2 to 4 times per month. 18% of respondents consumed soy sauce 1 time per month or least, while 16% of respondents consumed soy sauce every day.

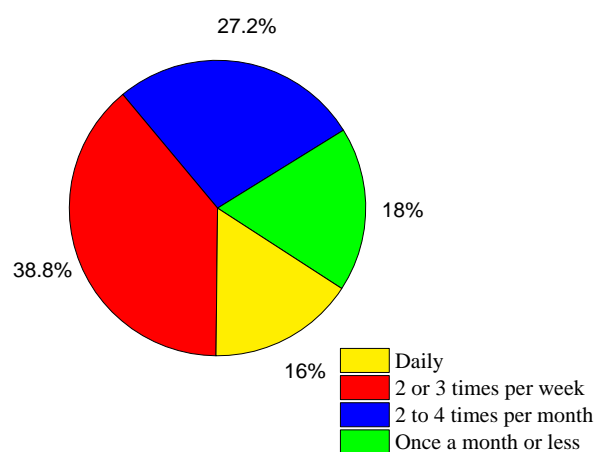


Fig. 1. Consumption of soy sauce by the respondents

The rate of soy sauce consumption in each family was different; there were 53.4% of participants consumed soy sauce less than one bottle per month, followed by 26.4% who consumed soy sauce one bottle per month (Table 2).

Table 2. Consumption of soy sauce by respondents per month

Frequency	Participants	Percentage (%)
One bottle per month	173	26.4
Two bottles per month	75	11.5
Three bottles per month	31	4.7
Least than one bottle per month	350	53.4
Other	26	4.0
Total	655	100

For estimating daily consumption, the total household size, number of soy sauce bottles used per month and the volume of soy sauce per bottle were used. As shown in Table 3, the minimum, maximum and average household

sizes in the survey consisted of 1, 14, and 4.5 people, respectively. This number was very close with the average number of Cambodian household size of 4.6 based on the census data from the national institute of statistics (NIS, 2013).

Table 3. Total number of residents currently residing in the household

Household size	Participants	Percentage (%)	*Valid percentage (%)
1	42	6.4	6.5
2	76	11.6	11.7
3	83	12.7	12.8
4	132	20.2	20.3
5	146	22.3	22.5
6	75	11.5	11.6
7	49	7.5	7.6
8	20	3.1	3.1
9	7	1.1	1.1
10	15	2.3	2.3
11	2	0.3	0.3
Missing	6	0.9	
Total	655	100	

*Valid percentage is the percent when missing data are excluded from the calculations.

The volume of soy sauce bottle and the design of the bottle were also very important in attracting the consumers as it was an innovativeness (Goldsmith et al., 2010). As shown in Table 4, about 31.3% of respondents used 450 mL soy sauce bottle, followed by 500 mL (20.8%) and 250 mL (18.5%) bottles, respectively.

Table 4. The volume of soy sauce per bottle

Soy sauce volume	Participants	Percentage (%)	*Valid percentage (%)
450	205	31.3	32.0
500	136	20.8	21.3
250	121	18.5	18.9
200	58	8.9	9.1
600	31	4.7	4.8
150	17	2.6	2.7
300	14	2.1	2.2
350	10	1.5	1.6
330	9	1.4	1.4
680	7	1.1	1.1
Missing	15		

According to Table 2, about 53.4% of people surveyed consumed soy sauce less than one bottle per month. As the consumption of soy sauce in Cambodia was still low, big bottles of soy sauce were not often produced by Cambodian soy sauce manufacturers. Approximately 42.6% of respondents consumed one to three bottles of soy sauce per month and the average daily consumption is 4.6mL. Even though soy sauce has been consumed by almost all

Cambodian people according to the survey, the consumption of soy sauce in Cambodia was still low about 4.6 mL or lower by comparing with the average of daily soy sauce consumption in China 8.1 mL (CCDCP, 2002), while the daily consumption of soy sauce in Japan was about 30 mL per person (Kobayashi, 2013). Based on the study of fish sauce, soy sauce, and vegetable oil fortification in Cambodia in 2013, the average daily soy sauce consumption in Cambodia was about 10 mL (Theary et al., 2013); therefore, the daily soy sauce consumption in Cambodia could be around 4.6 mL to 10 mL. Nowadays there are many soy sauces sold in Cambodia; soy sauce has many tastes and flavors such as saltiness, sweetness, sourness and the other tastes that were determined by sensory test. Some soy sauces had high amount of salt and sugars, while some other soy sauces had low amount of sugars. For example, Shiro shoyo or white soy sauce had salt concentration from 15% to 20% and 16.7% reducing sugars. On the other hand, Koikuchi shoyu or dark colored soy sauce reducing salt had salt concentration only 8.9% and 3.53% reducing sugars (Yokotsuka, 1986). In the survey, taste of soy sauce was divided into 6 groups for finding the soy sauce taste that Cambodian people like to eat such as salty, sweet, slightly salty, slightly sweet, salty sweet, and slightly salty and slightly sweet. As shown in Table 5, salty sweet is the taste that the respondents like the most, followed by slightly salty. Soy sauce brands and the soy sauce tastes were compared by using Chi square test with the signification $p < 0.05$. High consumption of salt or sodium can be very harmful for the health, especially for the people suffering from high blood pressure (He and MacGregor, 2010).

Table 5. Favorite taste for the respondents

Taste	Participants	Percentage (%)	p -value
Salty	31	4.7	
Sweet	31	4.7	
Salty and sweet	400	61.1	
Slightly salty	141	21.5	0.007*
Slightly sweet	16	2.4	
Slightly sweet and slightly salty	36	5.5	
Total	655	100	

* Soy sauce brands and tastes were compared using Chi-square test (Pearson) with the signification $p < 0.05$.

For making soy sauce, high amount of salt is needed but it is not good for health if consume much salty soy sauce. Seeing this issue, there is more and more interesting research on reducing salt in soy sauce fermentation for making a slightly salty soy sauce (Song et al., 2015). In the future as people become more knowledgeable with healthcare, low sodium soy sauce could be a popular product in Asian countries.

The price of soy sauce could effect the consumption of soy sauce in Cambodia. There were 53.10% of respondents

who consumed the soy sauces that cost 2500 – 3900 riels and 30.70% of respondents consumed the soy sauce that cost 4000 – 7900 riels, thus there were 83.8% of respondents who consumed soy sauces that have a price between 2500 and 7900 riels. Soy sauce brands and the cost per bottle were compared by using Chi square test with the signification $p < 0.05$ (Table 6).

Table 6. Soy sauce’s cost per bottle

Price	Participants	Percentage (%)	<i>p</i> - value
2500 – 3900 Riel	348	53.10	0.001*
4000 – 7900 Riel	201	30.70	
8000 – 11900 Riel	51	7.80	
12000 – 15900 Riel	31	4.70	
16000 – 19900 Riel	9	1.40	
20000 – 24000 Riel	3	0.50	
Higher than 240000 Riel	12	1.80	
Total	655	100	

*Soy sauce brands and prices were compared using Chi-square test (Pearson) with the signification $p < 0.05$.

There are many brands of soy sauce sold in Cambodia however, there are just 50 brands of soy sauce that were mentioned by 655 respondents. There are 9 soy sauce brands that have the percentage of consumption higher than 1%. Among that, soy sauces C2 (Cambodia’s soy sauce), V3 (Vietnam’s soy sauce), TH5 and TH3 (Thailand’s soy sauces) had the most consumption (Table 7).

Table 7. Favorite soy sauce brands used by respondents

Brand	Participants	Percentage (%)	*Valid percentage (%)
C2	212	32.4	33.4
V3	106	16.2	16.7
TH5	86	13.1	13.5
TH3	46	7.0	7.2
C5	35	5.3	5.5
J1	19	2.9	3.0
C10	15	2.3	2.4
F	10	1.5	1.6
C11	8	1.2	1.3
Missing	20		

*Valid percentage (%) is the percent when missing data are excluded from the calculations.

As described above, the favorite taste consumed by the respondents was salty and sweet, followed by the slightly salty. Four soy sauce brands that had the most consumption were selected to investigate their physicochemical characteristics to give some insight of the saltiness and their quality. As shown in Table 8, C2 and TH3 had the salt amount about 16.17% and 20.63%, respectively. These soy sauces brands which were also mentioned by the respondents in the survey that had the salty sweet taste. V3

and TH5 had salt content approximately 9.83% and 8.77%, respectively. These soy sauce brands of the slightly salty taste were mentioned by the participants that they like. By comparing the results with the Cambodia soy sauce standard CS 066:2011, TH5 was a soy sauce falling in the specification defined by the Cambodia soy sauce standard CS 066:2011). Not only taste and quality but also the price, the innovativeness, and the brand loyalty that are very important to attract the consumers (Goldsmith et al., 2010). By looking at the price, C2 had a cheap price which costed 2000 to 2500 riels per 450 mL plastic bottle and their handicrafts has established since 1981. V3 costed 3000 to 3500 riels per 250mL plastic bottle; TH5 costed 7000 to 8000 riels per 600mL glass bottle and TH3 costed 3500 to 4000 riels per 300 mL plastic bottle. Therefore, the price, the taste, the design of the bottle, innovativeness, brand loyalty and the quality are very important to attract the consumers.

Table 8. Physicochemical quality of the most consumed soy sauces

Parameters	Soy sauce brands				
	C2	V3	TH5	TH3	CS
Salinity (%)	16.17±0.06	9.83 ± 0.06	8.77 ± 0.06	20.63±0.12	≤ 20%
SSFSC (%)	2.3 ± 0.05	8.17 ± 0.14	27.72±0.18	2.97±0.61	≥ 15%
AN (%)	0.19 ± 0.03	0.25 ± 0.01	0.93 ± 0.02	0.10±0.02	≥ 0.26%
TN (%)	0.41 ± 0.05	0.6 ± 0.05	1.98±0.02	0.25±0.05	≥ 0.8%
pH	4.35 ± 0.01	4.44 ± 0.01	4.85±0.03	4.07±0.02	4.2-4.6

CS: Cambodia soy sauce standard CS 066:2011. SSFSC: Soluble salt free solid contents. AN: Amino nitrogen. TN: Total nitrogen. All samples were performed in triplicate, all results were significant different ($p < 0.05$).

Soy sauces can be found and bought at many places in Cambodia such as home store, supermarket, local market etc. As shown in Fig. 2, 38.46% of respondents bought soy sauce from local markets, followed by 31.47% of respondents who bought from the home store, 26.97% of respondents bought from supermarket and 3.1% of respondents bought soy sauce from other sources or homemade.

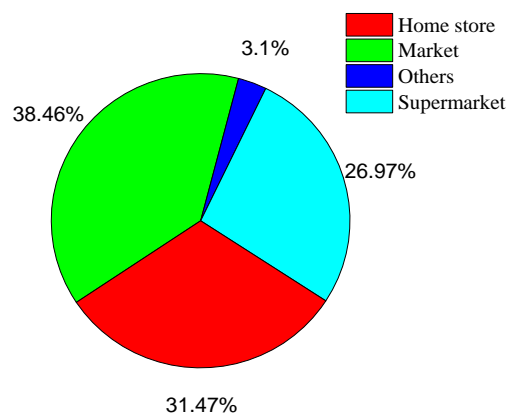


Fig. 2. Purchasing soy sauce location by the respondents

In the survey, there were 98.90% of respondents who support the development of new soy sauce product that is safe and has high quality. Therefore, a good quality of Cambodian soy sauce made by fermentation should be developed.

4. CONCLUSIONS

According to the survey, soy sauce brands (C2, V3, TH5 and TH3) were the brands that were consumed by most of the respondents. Among them, C2 (Cambodia's soy sauce) and TH5 (Thailand's soy sauce) had salt amount more than V3 (Vietnam's soy sauce) and TH3 (Thailand's soy sauce). By comparing with Cambodia soy sauce standard, TH5 (Thailand's soy sauce) had higher quality than C2, V3, and TH3. Salty sweet taste was the favorite taste mentioned by the respondents followed by the slightly taste. The price, the taste, the quality and the design of the bottle are also very important to attract the consumers.

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