

An Investigation into Chopsticks (Disposable versus Reusable)

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ABSTRACT

This report aims to determine whether or not disposable or reusable chopsticks are suitable for student usage in the New Student Union Building (SUB) at UBC. Every year, approximately 350,000 pairs of disposable chopsticks are thrown away on UBC campus. This is a problem in the long run and the aim of the new SUB is to reduce the carbon footprint of students in the new SUB, the aim of this report is to minimize that from disposable utensils such as disposable chopsticks. An analysis is conducted on the two products based on the environmental, economical, and social impacts of disposable and reusable chopsticks.

Reusable chopsticks are usually made out of plastic and metal whereas disposable chopsticks are wood and bamboo. Even though Canada is abundant with forests, it is important to acknowledge that it is not an unlimited source of material. After surveying a small sample population within users of the SUB, we have found that more than 80% of the participants are willing to bring their own reusable chopsticks if they were given a discount of some sort when purchasing their meals. This report concludes that reusable chopsticks are a much more sustainable option than disposable chopsticks as UBC strives to be a global leader in sustainability. By implementing cheap vending machines in the new SUB providing cheap reusable chopsticks will help raise awareness of the issues regarding disposable utensils. This will also encourage students and staff members not only to bring disposable utensils to school, but even to other places in Vancouver. It is recommended for washing stations to be implemented around the new SUB if reusable chopsticks are replacing disposable chopsticks.

GLOSSARY

- Disposable:** Intended to be used once and then thrown away.
- Melamine:** A white crystalline compound, $(\text{CNH}_2)_3\text{N}_3$, made by heating cyanamide and used in making plastics.
- Organochlorine:** Chlorinated hydrocarbon (organochlorine) insecticides, solvents, and fumigants are widely used around the world. This class comprises a variety of compounds containing carbon, hydrogen, and chlorine. These compounds can be highly toxic, and some agents, such as DDT, have been banned in the United States because of their unacceptably slow degradation and subsequent bioaccumulation.
- Polyphenylene Sulfide:** An organic polymer consisting of aromatic rings linked with sulfides.
- Pulp:** Pulp may then be used directly to make unbleached papers, or bleached for white papers. Pulp may be fed directly to a paper machine in an "integrated papermill" or dried and pressed into bales to be used as a raw material by papermills worldwide.
- Reusable:** Capable of being used again.

LIST OF ABBREVIATIONS

- AMS: Alma Mater Society
- B.C.: British Columbia
- FDA: Food and Drug Administration
- PPS: Polyphenylene Sulfide
- SUB: Student Union Building
- UBC: University of British Columbia
- WMS: Wood Market Statistics

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1.0 INTRODUCTION

Chopsticks are small sticks used in pairs of equal length as the traditional eating utensils of Asian countries such as China, Japan, Korea and Thailand. They are generally believed to have invented in ancient China. Chopsticks are commonly made of wood, plastic, metal, bamboo and some jewels such as ivory, jade, silver, and gold. With the spread of Asian culture and food, chopsticks are becoming more and more popular around the world. Asian food has gained great popularity in the past few years and also in UBC. There are some Chinese and Japanese restaurants around campus currently. Disposable chopsticks are used extensively in these restaurants.

The aim of this report is to conduct a triple-bottom-line assessment on the disposable chopsticks used in the current SUB and a possible substitute for the product. A conclusion will be drawn on which of the two is more suitable for new green vending machines in the new SUB. The environmental, economic and social aspects of the two products will be analyzed. The environmental aspect focuses on the eco-footprint of producing the products and their effects on Canadian ecosystems. The economics aspect of the assessment aims to provide information about the costs of production, and acquiring the products. The social aspect of the two products will focus on the health concerns of chopstick users. In conclusion, this report will make a final recommendation for the most sustainable product to introduce to the new vending machines in the New SUB.

2.0 TYPES OF CHOPSTICKS

The purpose of this section will be to discuss the two different types of chopsticks which we will be focusing on: reusable and disposable chopsticks. Herein, we will analyze the benefits and drawbacks in investing in each type of chopstick by performing a triple bottom line analysis.

2.1 Disposable Chopsticks

2.1.1 Economic analysis

Disposable Chopsticks Industry in General (From Economical Perspective)

The disposable chopstick industry is massive. By in large, China is the largest producer and consumer of disposable chopsticks. As Chinese culture spreads throughout the world, so too do chopsticks. In China, a jaw-dropping 100 acres of trees are cut per day to keep up with demand for disposable utensils, according to Greenpeace China (Sufrin, 2010); that works out to about 16 to 25 million trees per year. Furthermore, according to the Associated Press, this adds up to 1.66 million cubic meters of timber or 25 million fully grown trees every year. Assuming usage of Douglas fir and evergreen trees in the production of disposable chopsticks, the costs average out to \$90 per cubic meter of chopsticks. 1.66 million cubic meters per year would total USD \$149,400,000.

A majority of disposable chopsticks manufacturers are located in the city of Guangzhou. In this city, there are 100,000 people employed by the chopsticks industry (Sufrin, 2010). It is also important to note that according to the China Labor Consultation Network, the minimum wage is \$198.75/month in Guangzhou; suggesting that the industry is paying \$19,875,000/month and \$238,500,000/year USD in manufacturing costs.

Disposable Chopsticks at UBC

Asian foods have gained remarkable popularity in BC in the past decade and UBC is not an exception. There are currently few Asian style restaurants at the UBC Vancouver campus which are classified as “demanding restaurants”.

Disposable chopsticks are used extensively throughout these restaurants. The AMS (Alma Mater Society) inventory department is responsible for ordering chopsticks for the two Asian restaurants in the UBC SUB (Student Union Building). We have contacted the manager of this department in order to obtain statistics on the number of chopsticks used in these restaurants; the results for usage for four-months are as follow:

| Restaurants | July | August | September | October | Average |
|-------------|-------|--------|-----------|---------|---------|
| 1 | 8,000 | 12,000 | 20,000 | 24,000 | 16,000 |
| 2 | 3,200 | 2,500 | 7,500 | 8,400 | 5,400 |

Table 1: Numbers of chopsticks used (Numbers shown indicates quantity)

The figures from the table above indicate that the number of chopsticks used in these restaurants fluctuates enormously. In order to have an accurate estimation on the quantity of chopsticks used per year in these two restaurants, we have found the average quantity used per month by adding the numbers we have for the-four months period and dividing them by the number of months. This suggests there are 192,000 chopsticks used in restaurant 1 and 64,800 units in restaurant 2.

In order to calculate the annual cost of chopsticks for these two restaurants, the price per unit of chopsticks is required. The price of chopsticks depends on manufacturing material, quality, and quantity. An average disposable wooden chopstick costs USD \$0.15 which makes the total chopsticks cost for these two restaurants together to \$38,520 annually (Gregory, 2011).

2.1.2. Environmental Analysis

According to the Wood Market Statistics, just in the year 2009 alone, the estimated harvest amount of Canadian forests is 680,808 hectares. Table 2 shows Canada's land area, in hectares. The table shows how much of the land is available for commercial harvest. As shown, the amount of land in Canada available for commercial harvest is about 294.8 million hectares. Canada harvests around 0.9 million hectares of those forests annually. Of the forests in Canada, the Aspen trees are needed for the production of disposable chopsticks. The Canadian boreal forest is abundant of these Aspen trees that are highly prized for its pulp.

Canada's Land Area, hectares

| | Forest Land | Other Wooded Land | Forest and other Wooded Land | Non-Forest Land | Total Land |
|---------------------------|-------------|-------------------|------------------------------|-----------------|-------------|
| British Columbia | 57,910,000 | 6,337,000 | 64,247,000 | 27,397,000 | 91,644,000 |
| Alberta | 27,718,000 | 8,670,000 | 36,388,000 | 25,011,000 | 61,399,000 |
| Saskatchewan | 20,043,000 | 4,215,000 | 24,258,000 | 34,558,000 | 58,816,000 |
| Manitoba | 18,968,000 | 17,386,000 | 36,354,000 | 17,641,000 | 53,995,000 |
| Ontario | 53,758,000 | 14,536,000 | 68,294,000 | 19,816,000 | 88,110,000 |
| Quebec | 73,360,000 | 11,215,000 | 84,575,000 | 48,395,000 | 132,970,000 |
| New Brunswick | 6,091,000 | 116,000 | 6,207,000 | 922,000 | 7,129,000 |
| Nova Scotia | 4,240,000 | 107,000 | 4,347,000 | 930,000 | 5,277,000 |
| Prince Edward Island | 265,000 | 8,000 | 273,000 | 292,000 | 565,000 |
| Newfoundland and Labrador | 10,730,000 | 9,337,000 | 20,067,000 | 15,311,000 | 35,378,000 |
| Yukon | 7,884,000 | 14,906,000 | 22,790,000 | 23,808,000 | 46,598,000 |
| Northwest Territories | 28,352,000 | 4,994,000 | 33,346,000 | 78,508,000 | 111,854,000 |
| Nunavut | 815,000 | 125,000 | 940,000 | 187,427,000 | 188,367,000 |
| Canada | 310,134,000 | 91,952,000 | 402,086,000 | 480,016,000 | 882,102,000 |

Source: Canada's National Forest Inventory - CanFI 2001. <https://nfi.nfis.org/history.php?lang=en>

Table 2

Improper timber extraction can lead of increase of rainwater runoff levels to the streams and rivers. The resulting sedimentary runoff from the logging roads into valley watersheds will pollute local rivers and streams and kill off much of the fish. Moreover, approximately 150,000 tons of organochlorine chemicals are dumped into our rivers and coastal waters causing even greater environmental hazards (Miller,

1997). The destruction of the forests makes an enormous impact on the animals. The loss of animal travel gateways in Alberta and B.C. poses a threat to caribous, deer, elks and grizzly bears. Companies are legally obligated to replant the forests they cut down. However, no matter how successful the replanting efforts are, the diversity or the original health of the ancient forests can never be restored. Replanting small seedlings cannot replace an ecosystem that took thousands of years to evolve.

2.1.2. Social Analysis

Disposable chopsticks are commonly found in food courts, and restaurants that we visit in our daily lives. In the manufacturing process, bleach and artificial preservatives are used. Shen et al. (2008) has conducted an experiment on twenty four different types of disposable chopsticks on the market and assessed the possible metal contamination of disposable chopsticks. From the experiment, it was found that the total heavy metals contained in these chopsticks were 50.42 μ g/g. Manganese, zinc and copper were found to be heavy metal contaminants in the chopsticks. When these chopsticks are dipped in hot water, the sulfuric dioxide on the chopsticks becomes sulfuric acid, and released rate and pH were detected after metals are leached from the chopsticks. Table 3 shows the assessment of the health risks attributable to intake of heavy metals from the usage of disposable chopsticks. Negative health effects such as pathological changes in the nervous system and the possible induction of Parkinson disease was found by Luchhini et al. (2007). Moreover, Li et al. (2004) also found that manganese exposure induces oxidative stress, inhibiting macrophage cell function in the lungs.

| Heavy metals | RfD (mg/kg-day) | Hazard quotient (HQ) |
|---|-----------------------|----------------------|
| Cr | 3×10^{-3} | 0 |
| Cd | 1×10^{-3} | 0 |
| Cu | 4.3×10^{-2} | 0.661 |
| Mn | 5×10^{-2} | 0.614 |
| Ni | 2×10^{-2} | 0.015 |
| Pb | 1.43×10^{-3} | 0.000 |
| Zn | 3×10^{-1} | 0.032 |
| Hazard index (HI= ΣHQ) | | 1.322 |

^aHazardous Index method.

Table 3 (Shen et al., 2008)

Disposable chopsticks contain hazardous amounts of heavy metals, as found in the study conducted by Shen et al. Thus, it is recommended to bring reusable chopsticks. Additionally the disposal of 30 billion pairs of chopsticks each year is an environmental problem involving not only an accumulation of trash but also the annual felling of 3 million trees. To ensure the health of our students and staff, we should promote the usage of non-disposable tableware.

2.2 Reusable Chopsticks

2.2.1 Economic analysis

Reusable Melamine chopsticks are great alternatives for the disposable chopsticks. The unit cost of Melamine chopsticks really depends on the quality of the material used. The price ranges from USD \$0.07-0.60 but an average Melamine chopsticks costs \$0.07-0.16. Previously mentioned, there are 256,800 pairs of chopsticks used annually in the two restaurants addressed above. Assuming each unit of Melamine chopsticks cost \$0.12, the total annual cost of using this type of chopsticks would add up to \$30,816. This would not only help saving the environment, it would also allow the two restaurants to save \$7,704 annually (Gregory, 2011).

2.2.2. Environmental analysis

Two common types of reusable plastics suitable for chopsticks are melamine and Polyphenylene Sulfide (PPS). Melamine and PPS chopsticks are currently only available from suppliers located in mainland China. The environmental impact from shipping these types of chopsticks to Canada will be small due to their size and weight, and can be comparable to that of disposable chopsticks already used in the SUB (also shipped from China). The focus of this environmental analysis will be on melamine due to its greater availability and less financial cost. The following discusses the synthesis of melamine and its associated environmental hazards.

The synthesis of melamine produces gases such as carbon dioxide and ammonia as co-products. While the ammonia and carbon dioxide formed from the chemical reactions involved in the synthesis of melamine can be recycled to a urea plant and used to produce urea, the high pressures and temperatures required for such a reaction to occur require high energy inputs. The requirement of high energy to reach polymerization temperatures will inadvertently lead to significant greenhouse gas emissions. Waste water is also produced as a by-product and can be recycled back into the melamine plant or used to cool the melamine plant as cooling water makeup. There is no solid, liquid, or gaseous discharge into the environment from the chemical reactions involved in producing melamine. However, this requires that the melamine plant is used in combination with a urea plant (Eurotecnica, 2011).

The production of plastic requires melting before it can be cut into small pellets and shipped to manufacturers. The melting temperature of melamine is approximately 350 degrees Celsius (Kohlmann, 1998). This is in contrast to the

melting temperature of steel (for reusable stainless steel chopsticks) which is approximately 1370 degrees Celsius (UCSD, 2011) and the melting temperature of PPS which is approximately 285 degrees Celsius (Georgia Institute of Technology, 2011).

The effect of melamine on the surrounding environment has been found to be low by a number of studies and reports (Eurotecnica, 2011), (Kohlmann, 1998). According to one particular study carried out by the United Nations Environment Programme, melamine has been shown to have low ecotoxicity from data available from different species and trophic levels, and no relevant risk for the environment (Kohlmann, 1998).

Reusable plastics differ from disposable plastics for their durability; their ability to be washed without corrosion and their resistance to heat. For this reason, they require significantly high melting temperatures to produce which will cause greater greenhouse gas emissions. However, a major benefit in the use of reusable plastic, and indeed, the reason we propose this material as a viable alternative to disposable chopsticks, is the fact that it is not meant to be disposed of or recycled. Therefore, it is strongly advisable from an environmental standpoint to use reusable plastic chopsticks.

2.2.3. Social Analysis

Just as with disposable chopsticks, there are minor ethical concerns regarding the use of reusable chopsticks. Reusable chopsticks made from melamine are purported to be non-toxic by manufacturers (Quanzhou Deli Plastic Ltd., 2011), (Kaihua County Hao Teng melamine Products Factory, 2011), however, there is

evidence suggesting a risk of cancer or renal failure from melamine ingestion (International Agency for Research on Cancer, 1993), (Kohlmann, 1998). Therefore, while it is important to note that melamine is a thermoplastic (i.e. resistant to high temperatures), there is a small amount of solubility in water over long periods of time; even at room temperatures (Kohlmann, 1998).

According to the World Health Organization, the tolerable daily intake of melamine is 0.2 mg per kg of body mass (Endreszl, 2008). This means that for a male of average weight in Canada (82.7 kg), a daily intake of 16.57 mg of melamine can be tolerated without bigger health risks. The FDA states that when melamine is absorbed into the blood stream, it can crystallize and damage renal cells, ultimately causing Kidney malfunction (Weise, 2007). The tolerable daily intake set by the FDA is 0.063 mg of melamine per kg of body weight (Weise, 2007). However, it is also important to mention that the risk of ingesting melamine from reusable chopsticks is low due to its low solubility (Kohlmann, 1998).

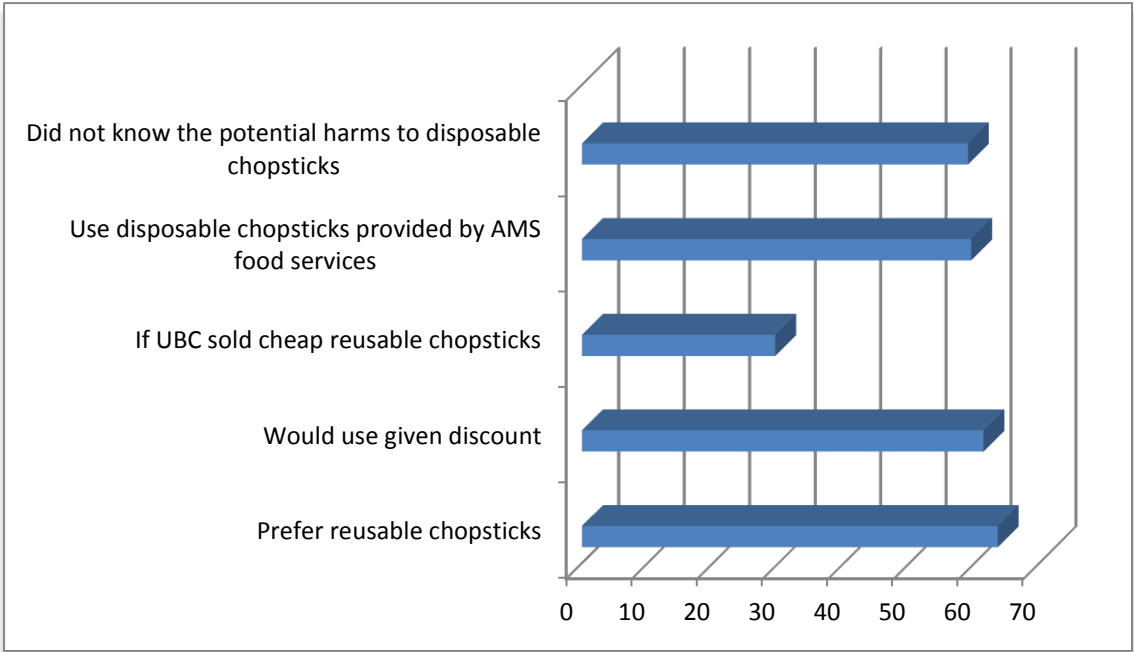
In addition, the health risks associated with the use of melamine are comparable to the risks associated with the use of any kind of chopsticks. Furthermore, while the production and synthesis of reusable chopsticks requires more energy due to its thermoplastic nature (Georgia Institute of Technology, 2011), it is more ethical than the production of disposable chopsticks, which although may require less energy, are only used once and often do not get recycled.

3.0 SURVEY

The purpose of this section will be to discuss the two different types of chopsticks which we will be focusing on: reusable and disposable chopsticks. Herein, we will analyze the benefits and drawbacks in investing in each type of chopstick by performing a triple bottom line analysis.

3.1 Survey Results

Almost 50 people participated in the survey; they were all UBC students ranging from 18-22 years old. 45% of the students were APSC students, 3% were arts and science students, while the rest are from law, pharmacy, and different departments. The results show that more than 63% the participants prefer reusable chopsticks as opposed to disposable either because the food tastes better or they thought that it was more sustainable. Approximately 61% of the participants are willing to bring reusable chopsticks if they were given a discount upon purchase and 60% of them are using the chopsticks provided by AMS food services. Furthermore, 59% of them were unaware of the possible negative health effects of using disposable chopsticks. However, 34% of the participants would not bring reusable eating utensils and 30% of the participants are interested in purchasing reusable chopsticks from UBC.



4.0 CONCLUSION AND RECOMMENDATIONS

The total cost of disposable chopsticks annually exceeds the cost of reusable chopsticks. An average disposable wooden chopstick will cost the restaurants in the SUB \$38,520 annually. Assuming each unit of Melamine chopsticks cost \$0.12, the total annual cost of using this type of chopsticks would add up to \$30,816. This will allow the AMS food services to save \$7,704 annually. Furthermore, reusable chopsticks are more ethical in terms of continual use due to the environmental problems associated with producing and disposing disposable chopsticks. The production of disposable chopsticks will pollute local rivers and streams and kill off much of the fish. In addition, organochlorine chemicals are dumped into our rivers and coastal waters (Miller, 1997) and many negative effects must be endured by animals. There are also significant health effects for humans including possible induction of Parkinson disease was found by Luchhini et al. (2007).

In contrast, reusable chopsticks have no solid, liquid, or gaseous discharge into the environment from the chemical reactions involved in producing melamine and no relevant risk for the environment (Kohlmann, 1998). Furthermore, the health effects of using reusable chopsticks are minimal and the production is highly ethical given its reusability. We also recommend a washing station located in the cafeteria of the SUB in order for students to clean and reuse chopsticks.

Following our triple-bottom-line analysis, we believe it is very important for the reputation of UBC, as a leader in sustainability, to discontinue the use of disposable chopsticks in the new SUB and adopt reusable chopsticks made from Melamine.

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APPENDIX A – Survey

Which faculty are you currently studying in?

- APSC
- Arts
- Commerce
- Education
- Forestry
- LFS
- Science
- Other:

Do you use chopsticks?

- Yes
- No

Do you prefer reusable or disposable chopsticks?

- Reusable
- Disposable
- I don't use chopsticks

Why would you choose disposable ?

- It is convenient

- It is more hygenic
- It is more readily available
- I don't use disposable chopsticks

Do you use reusable chopsticks?

- Yes
- No

Why do you choose reusable chopsticks?

- The food tastes better
- It is more sustainable
- I don't use reusable chopsticks
- Other:

Do you use the chopsticks in the SUB cafeteria?

- Yes
- No

You would bring a pair of reusable chopsticks if...

- You get a discount
- They were available to buy for a cheap amount
- I would not bring reusable utensils
- Other:

Did you know that disposable chopsticks can be harmful to your health?

- Yes
- No

Did you know that approximately 45 billion pairs of chopsticks are produced each year?

- Yes
- No

Did you know the amount of trees cut down each year to produce disposable chopsticks would cover a span 1 thousand times larger than UBC?

- Yes
- No

If UBC sold reusable chopsticks at the SUB, would you consider buying a pair?

- Yes
- No

Do you think it is important to use reusable chopsticks rather than disposable chopsticks?

Please feel free to write any comments in regards to the usage of chopsticks on UBC campus *

APPENDIX B- Survey Comments

“The chopsticks are pretty bad quality anyways, so the probability of ppl switching to reusable is quite high”

“I think reusable chopsticks on campuses is a great idea and should really be put

forward.”

“There are a lot of chopsticks wasted every day.”

“I thought the cost of chopsticks in the sub is already included in the meal.”

“The number of ppl using disposable chopsticks is very high since no one would really “bring their own chopsticks or utensils to school if they are buying lunch...”

“Depends on the situation, if I only had my purse, I wouldn't want to put used chopsticks in it, so I would want to have disposable ones. If I had a backpack and lunch bag, then sure, I would bring reusable ones.”

“The only way to replace the disposable chopsticks (and utensils) is really either to supply reusable ones, and the manpower required to clean them, or encourage people to bring their own sets from home.”

“Chopsticks usage can be reduced if they are not just lying around for people to take.

“I will try to use reusable chopsticks next time”

“Without some incentive, it's hard to find anyone carrying reusable chopsticks around.”

“Bringing reusable chopsticks are a hassle because you need to wash them and so forth afterwards.”

“The number of ppl using disposable chopsticks is very high since no one would really bring their own chopsticks or utensils to school if they are buying lunch...”

“I'd like to be able to buy a reusable one in ubc”