

An Investigation into the Replacement of Packaged Granulated Sugars by Liquid Sugars

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Abstract

This report presents the triple bottom assessment of switching from the traditional granulated packaged sugar currently being used by the UBC Food Services, to liquid sugar. The drive of this project is to decrease the waste produced by the granulated sugar packets.

The data presented in this report is limited to only a few cafes on campus, as the switch is not campus wide. For our analysis, we took into consideration two cafés; The Loop Café, where liquid sugars have temporarily replaced granulated packaged sugars, and Café Perugia that serves only granulated sugar. This was done so that the results in the survey are unbiased. It is important to note that the current provider of granulated sugar to UBC Food Services also provides the liquid sweeteners, and all research conducted was requested to be based on the products provided by this supplier. Variability by manufacturer/ supplier will not be taken into consideration in the scope of this project.

The first step taken was achieving a general understanding of the background of the project. The team then carried out a triple bottom assessment to evaluate if the switch was a sustainable option. From an economic viewpoint, since the UBC Food Services is the end consumer, our evaluation would be influenced by cost per package, differences in consumption, shrinkage, and maintenance. Environmental considerations included waste created by packaging, waste products from manufacturing, and energy consumption. For the social aspect it was determined that customer satisfaction, taste and texture, and resistance to change would be factors considered in our investigation. A survey was then carried out on a small sample of the UBC population; it was found that the customers are satisfied with the switch.

Switching to the liquid sugar, eliminates the issue of waste. However, liquid invert sugar is usually obtained from granulated sugar, increasing the number of processes involved as well as energy required. From the economic analysis, it was found that the liquid sugar costs 5.6 times more than the packaged sugar. Socially, the customers received the switch positively but poorer nutrition associated with the liquid sugars raises the issue of health risks such as obesity and possibly diabetes.

In conclusion, the results found show that continuing to use the granulated packaged sugar is the more sustainable option as the cost of the switch is not justified by any reduction of waste seen. A feasible recommendation that can be made to UBC Food Services is using a dispenser for the granulated sugar; this eliminates the issue of wastage while maintaining low product costs.

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Glossary

Agave- a plant found in Mexico that produces agave nectar, used commercially in sweeteners.

Centrifuge- an equipment that rotates around a fixed axis to separate particles based on density differences.

Invert sucrose- a mixture of fructose, glucose and liquid sugar, used primarily in sweeteners.

Effluent- an output solution from a man-made structure or process.

Biodegradable- a type of waste which can be broken down by oxygen and micro-organisms.

Biomass- biological material from living organisms.

Metabolic disease- any disorders that disrupt the normal process of converting food into energy.

List of Abbreviations

UBC- University of British Columbia

GFS- Gordon Food Service

ILO- International Labour Organization

CIRS- Centre for Interactive Research on Sustainability

1.0 Introduction

Currently UBC Food Services provides a variety of complimentary sugar products as sweeteners for beverages that are sold at its various cafes across campus. Among the sweeteners are the packaged sugars seen in Table 1. Additionally, recently UBC Food Services has temporarily introduced liquid sweeteners to select cafes across the UBC campus to in an attempt to decrease waste due to packaging. However, a triple bottom analysis will be completed on this project to evaluate the two options with respect to environmental, social, and economic factors to determine the more sustainable option. The liquid sweeteners that have temporarily been implemented in locations such as the Loop Cafe and Magma Cafe are shown in Table 2. As requested by our stakeholder, the triple bottom analysis will be done on the brands currently supplied to UBC, and alternative products will neither be considered nor assessed. The liquid sugar products investigated will be pure cane syrup and agave syrup, as the other two forms shown in Table 2 do not necessarily fall into the "sugar" category.

Table 1: Packaged sugars.

Sugar Tube Item	Brand
UBC Raw FS 007*	Rogers
UBC White FS 008	GFS
UBC Raw Sage 009	Sugar Stix Demerara
UBC White Sage 010	Sugar Stix Demerara
UBC Raw Cate 011	Organic Fair Trade
UBC White Cate 012	Organic Fair Trade

Table 2: Liquid syrups.

Liquid Sweetener Type	Brand
Pure Cane Syrup	Monin
Sugar Free Sweetener	
Honey	
Agave Syrup	

2.0 Environmental Considerations

Production

Granulated sugars are commonly processed from sugar beets or sugar canes although approximately 90% of the world's sugar is provided by sugar canes. Sugar canes are pulverized and added to a lime-water juice close to the harvest location, often South America, Central

America and Australia. The resulting mixture is clarified and boiled until the sugar crystallizes. The partially processed sugars are often stored and shipped in this form, then refined in local plants such as the Montreal and Vancouver plants operated by Lantic to make Rogers Sugar. Refining involves separation of the molasses from the sugar grains by centrifuge, followed by dissolving in water, washing, and clarifying to remove impurities. Filtration is done to remove solids and then the liquor is decolourised. Finally, the sugar liquor is evaporated into crystals, again centrifuged, then conditioned for several hours to allow moisture to escape. The final dry sugar granules are classified by size and packaged or further processed. A similar process is employed for beet-sugars, where beets, which may be sourced from as local as Alberta, are sliced, sugar is extracted, and impurities removed. The pulp is then evaporated and packaged, or further processed to produce liquid sugars.

Liquid sugars come in two forms: liquid sucrose and invert sucrose. Liquid sucrose is made simply by boiling and melting granulated sugar in pure water or alternatively with a raw sugar liquor. When using granulated sugar as the start material, production of liquid sugars involves additional processing stages, and therefore more energy consumption. However, when using raw sugar liquor, the crystallization stage is bypassed and a significant amount of energy is saved such that the energy consumption to produce liquid sugar is less than for granulated sugars. Liquid invert sugar is made by then converting 50% of liquid sucrose to equal parts fructose and glucose, making it sweeter than an equal volume of regular liquid sucrose. The syrups produced by Monin, are referred to as sweeteners, and therefore for this investigation, it will be assumed that all liquid sweeteners will fall into the category of inverted sucrose/sugar.

Several by-products of sugar processing are reused in the process itself, such as the use of waste cane fibres as fuel, and others are sold to other industries. However, in the comparison between packaged granulated sugars and liquid inverted sugar, the additional environmental consideration is the hot acid treatment and its effluent streams and by-products. Following the hot-acid inversion, typically the pH of the liquid sugar is adjusted by the addition of sodium or calcium hydroxide prior to subsequent cooling and concentration stages. Although no direct consequences are caused by these additional processing steps and the neutralized acid waste is safely disposable, the large amounts of hydrochloric acid are undesirable as there are several health and safety concerns associated with this, as well as problems such as corrosion.

Waste Management

UBC Food Services prides itself in knowing that all single-use products provided are fully biodegradable. One key factor that is considered when evaluating recycling programs is the portion of packaging that actually ends up in the correct stream because it is difficult to quantify and control consumer actions. However, biodegradable material can be disposed of through regular garbage, which eliminates this factor of individual responsibility. Once in the landfill, biodegradable products break down into carbon dioxide, water, and useful/safe biomass given a reasonable period of time; however, this is only possible given sufficient oxygen and

microorganisms. Thus, biodegradable products may be better than garbage, but the optimal alternative is a no-waste system. Additionally, biodegradable products are not always safe; they may break down releasing dangerous or toxic by-products and still be labelled "biodegradable", as the occurrence of these new materials is fairly recent and not yet fully standardized and understood.

Comparatively, the liquid sweeteners are not individually packaged, but rather are shipped in 1 L plastic containers with plastic pumps. UBC Food Services has stated that the plastic containers and pumps are disposed of into plastic recycling at the end of their useful life, although this "useful life" is not consistent and cannot be quantified. Plastic recycling does not eliminate the need for virgin plastic, but rather recycling allows replacement of wood or timber with recycled plastic. Another drawback is that plastic recycling requires additional input of energy, which is unfavourable for an environmental view.

3.0 Economic Considerations

As a complimentary product at cafes across the University of British Columbia (UBC), economic considerations must be taken when determining which form of sugar should be provided. As previously mentioned, of the four options available at cafes, only a comparison between liquid cane syrup and granulated sugar will be evaluated within this report. The economic analysis will consist of reviewing the cost, actual usage, shrinkage/theft and economic benefits.

Cost

The cost difference between granulated sugar and liquid cane syrup is rather excessive and must be considered when purchasing the product. Figure 1 calculates the cost difference between equivalent amounts of granulated sugar and liquid sugar. According to the calculations, liquid cane syrup is approximately 5.625 times more expensive than conventional granulated sugar. As a complimentary product at cafes this will lead to a major increase in cost assuming that customers use the same amount of liquid sugar pumps as they would for granulated sugar packets. Annually, this translates to a total of 3,246.32 dollars spent on granulated GFS/Rogers sugar. As seen in Figure 2, if the consumption of granulated sugar in UBC was replaced with equivalent volumes of liquid cane syrup, the total cost of sugar would rise to 16,008.00 dollars. The cost of using liquid cane syrup instead of granulated sugar greatly raises the costs for providing an item that is complementary.

Actual Usage

Since the quality of liquid cane syrup is higher than that of granulated sugar, customers are prone to consume more liquid cane syrup than they would granulated sugar. In the survey which was conducted at the Loop Cafe, customers took an average three times more liquid cane syrup pumps than they would granulated sugar. This leads to a higher amount of sugar consumed per annum and will lead to an increase in cost which will surpass the 5.6 times increase in cost that was calculated earlier. If customers consume more cane sugar pumps than granulated sugar

packets the total price for liquid cane syrup across UBC may reach values as high as 25,000-30,000 dollars.

Shrinkage and theft

A problematic aspect of sugar packets is the amount of extra packets that are taken but not consumed. Often, customers will take extra sugar packets in case they require more at a later time. These extra packets are usually not consumed and rather thrown away as waste due to inconvenience. By switching to liquid cane syrup the possibility of shrinkage is greatly reduced due to the nature of the product. Liquid cane syrup is difficult to store and thus customers are less likely to take extra cane syrup that they do not require. Although shrinkage is greatly reduced with liquid cane syrup there still has been a reported case of theft which involved a liquid cane syrup container being stolen. This was a one-time incident and usually containers are chained to counters which further deters theft, whereas granulated sugar theft is much more difficult to cite and prevent since sugar packets are much easier to steal. Thus, a switch to liquid sugar bottles would lead to greater efficiencies and reduce costs due to shrinkage and theft.

Economic Benefits

The company that supplies the liquid sugar products is Monin, a company based in France. Meanwhile granulated sugar may be produced and manufactured in Alberta, Canada by Rogers/Lantic. Rogers/Lantic is the largest sugar producer in Canada and generates approximately 1000 jobs across Canada. By purchasing packets of granulated sugar, UBC would be supporting Canadian farmers who produce sugar beets, and strengthening the Canadian economy. Since Rogers/Lantic is a large company, UBC's purchases of granulated sugar will likely not critically influence the revenue generated by Rogers/Lantic. However, as a post secondary institution with a strong presence in Canada, UBC's purchase of Rogers/Lantic sugar may influence other companies and institutions to purchase Canadian goods and support the Canadian economy.

If each packet costs 0.016 dollars for granulated sugar

Each packet in liquid sugar costs $\frac{12 \text{ dollars per container}}{132 \text{ packets per container}} = 0.09 \text{ dollars}$

cost increase is $\frac{0.09 \text{ dollars}}{0.016 \text{ dollars}} = 5.625 \text{ times more expensive}$

Figure 1: Cost comparison of granulated sugar vs. liquid cane syrup.

1 pump = 1 packet

pump dispenses 1/4 ounce and container is 33 ounces

*33 ounces per container * 4 packets per ounce = 176 packets*

$$\frac{176000 \text{ packets}}{132 \text{ packets per container}} = 1334 \text{ containers}$$

*Total Cost = 1334 containers * 12 dollars per container = 16,008 dollars*

Figure 2: Total cost of liquid cane sugar.

4.0 Social Considerations

Aesthetics

The social aspects of the triple bottom line assessment determined that aesthetics, health concerns and the effect on the farmers are the factors to be considered in our investigation. The durability and beauty of the plastics make it an attractive material for reuse. The plastic used to store the liquid sugar is suitable and doesn't have an effect on the liquid sugar. They are dishwasher safe which is an important factor because this reduces wastage as well as makes the jobs of the employees at the cafes easier as they do not have to manually wash the plastics, although this is compared to the sugar packs which require no effort to wash or clean. The cafes make use of industrial dishwashers, ensuring the customers that the plastics are clean and fit for reuse. A concern that was brought up by one of the customers was the fact that they do not feel too comfortable with different hands touching the pumps/nozzles when trying to get sugar, and this poses the question of how sanitary it is.

Community Impact

Liquid sugar is produced from granulated sugar; thereby increasing the number of processes or stages involved, creating more job opportunities for people. An increase in job opportunities increases a country's gross domestic product and is also believed to reduce the crime rate in an area. Through research, it was observed that 10% of the sugar used is obtained from raw beet sugar produced locally in Canada and that approximately 90% of the raw sugar are cane sugar imported from tropical regions. In a conversation with our stakeholder, Victoria Wakefield, we asked about switching to fair trade sugar, as this would improve the welfare of the farmers that

produce the sugar. Fair-trade International is an organization that helps ‘promote trade justice internationally’ through setting standards that must be met for all products that bare the certified Fair Trade logo (Fair-trade International, 2004). There are two sets of standards, one that applies to all Fair Trade products and the other, which is designed specifically for a category of products. Under sugar production, they separate the principles into two categories, one for trade standards (pricing) and the other for producer standards (Fair-trade International, 2004). Labour condition requirements for small producers must meet the International Labour Organization (ILO) Standards. Fair-trade is committed to the economic and social development and empowerment of smallholder farmers and workers on hired labour farms. This increases the income of the producers of the sugars as well as provides extra income with which to improve their lives of both farmers and workers. Switching to fair trade liquid sugar is more expensive than the liquid sugar provided and this might come at a cost to the customers, as the sugar currently provided is complementary.

Nutrition

Because of the additional stage of processing, there is a resulting difference in the nutrition of the different sugar products. According to the Monin company website, one pump of a Monin liquid product (1/4 fl. Oz) is equivalent to the flavour in one package of granulated sugar. Product usage quantities received from UBC Food Services indicate that each packet of white and plantation sugar contains on average 3.5 grams of product. Therefore, for comparison of nutrition, 1/4 fl.oz and 3.5 g quantities of liquid and granulated sugars, respectively, will be used.

As can be seen in Table 3, comparison of nutrition of all sweeteners found that the highest caloric and carbohydrate intake was from the pure cane syrup and the lowest was from the granulated sugars. Granulated raw sugars contain identical nutritional nutrition values as white sugar, however may be slightly healthier as they generally lack the chemical additives that are used in bleaching and refining white sugar.

Nutrition Facts			
Product	Quantity	Calories	Total Carbohydrates (as Sugars)
Rogers White Sugar	3.5 g	13.125	3.5
Rogers Plantation Raw Sugar	3.5 g	13.125	3.5
Pure Cane Syrup	1/4 fl. Ounce	25	6.25
Agave Syrup	1/4 fl. Ounce	15	4.25

Table 3: Comparison of nutrition of sugar products for equivalent usage quantities for equivalent sweetness.

Sugar in any form does not contain much nutritional value but granulated sugar evidently causes less damage and uses fewer chemicals. Furthermore, as mentioned earlier, the customers use more liquid sugar than packaged sugar even though it is sweeter and this further increases potential health risks. Studies on the link between sugars and diabetes are inconclusive, with some suggesting that eating excessive amounts of sugar does not increase the risk of diabetes, although the extra calories from consuming large amounts of sugar can lead to obesity, which may itself increase the risk of developing this metabolic disease.

Survey

In order to investigate the social impacts of liquid sugar, we decided to conduct a survey on customers' consumption habits, satisfaction, and reaction toward the change from the traditional sugar packets to the liquid pumps. The survey was done at two UBC Food Services; the first survey was done at Loop Café, located inside the Centre for Interactive Research on Sustainability (CIRS) Building, and the second survey was conducted at Café Perugia located within the Life Science Centre.

The Loop Café currently provides liquid sugar to its customers. Thus, several customers were approached and asked questions about whether they had tried the coffee with liquid sugar, whether they preferred this to sugar packets, whether they agree with UBC's decision towards the substitution of sugar packets by liquid sugar pumps, etc. The survey and its results are found in Appendix A Part I. Most customers reported to have tried coffee with liquid sugar provided at Loop café, and 64% of the customers felt that liquid sugar is better than the regular sugar packets in the other cafés with reasoning that liquid sugar tastes sweeter than regular sugar packs, blends faster and more thoroughly with the coffee, and lacks the "sandy" feeling associated with granulated sugars in hot beverages. When asked about their opinion on the change towards liquid sugars, 100% of the customers agreed and supported UBC's decision to be sustainable by reducing paper waste resulting from the regular sugar packs. Customers' sugar consumption habits were investigated by asking how many pumps customers add to their coffee. We found out that customers usually add 3-4 pumps into their coffee (1 pump of liquid sugar = 1 regular sugar pack), compared to only 1-2 packs when using granulated sugar; customers tend to increase their sugar consumption when they put liquid sugar in their coffee.

A similar survey was conducted at Café Perugia where only the traditional granulated sugar packets are provided complementary to hot beverages. As in the previous survey, we approached several customers and asked them questions on how well the customers knew about liquid sugar

and what they thought about UBC's decision to change the regular sugar packets to liquid sugar pumps. For further detail on the survey questions, refer to Appendix A Part II. Based on the survey results, only 3 out of 10 people were not familiar with liquid sugar, so our team informed them about liquid sugar and about UBC's initiative towards sustainability that has them considering switching from regular sugar packets to liquid sugar pumps to reduce the paper waste resulting from sugar packs. All survey participants were then asked whether they agree toward the change and again all of the customers agreed with the change, and supported the movement towards liquid sugars.

Our team concluded that we have achieved the objectives of the surveys that were conducted at the two locations. It was determined that customer's habit of increasing sugar consumption when using liquid sugar is likely due to its preferred taste and texture. The increased consumption further indicates that the economic analysis and nutritional analysis completed on the assumption of equivalent volumes of sugar packs and liquid sugars is conservative. Thus, liquid sugar is even more expensive and detrimental to health than calculated.

5.0 Conclusion & Recommendation

A triple bottom analysis conducted on the potential switch from granulate packaged sugars to liquid sugar pumps investigated environmental, economic and social impacts on the sustainability at UBC. From an environmental point of view, since the production of liquid sugar often requires further processing of granulated sugar, it consumes a significantly larger amount of energy compared to the energy required to produce regular sugar packets. Additionally, for the liquid invert sugar, although the hydrochloric acid used in the hot-acid inversion stage can be neutralized and safely disposed of, the use of large amounts of acid is undesirable and poses potential safety hazards. The waste produced at the end of useful life for the liquid sugars is the plastic bottles and pumps in much less volume than the paper waste produced by the single-use sugar packets. Furthermore, the plastic waste which can be recycled uses a reliable and well understood process, although it requires additional energy for recycling. The biodegradable paper waste from the sugar packets uses a less understood technology that is effective only when enough oxygen and bacteria is present, but requires no additional energy. For the economic impact on the switch, it was determined that the annual cost on providing liquid sugar is more than five times the cost of regular sugar packs, and purchasing sugar packets supports Canadian economy as the Lantic/Rogers company is operated in Canada, and sugar beets may be grown in Alberta. Lastly with regards to the social impacts from the switch, it was observed that consumers preferred the liquid sugar more, but they also have a tendency to increase their sugar consumption when using liquid sugar. Additionally, the liquid sugar was found to be less "healthy" compared to the sugar packs, but more aesthetically pleasing.

With the completed triple analysis, it is recommended that UBC continue using granulated sugar packs since the annual cost of liquid sugar is far too high to justify the better taste and texture desired by the customers. Additionally, more energy needed for liquid sugar production and end-of-life plastic recycling, voids the argument that reducing paper waste from the regular sugar packets decreases effects on the environment and increases sustainability. In order for UBC to be

sustainable by reducing paper waste produced from regular sugar packs, it may be desirable to investigate a switch from single-use sugar packs to a sugar hopper, which would reduce waste without consuming more energy and operating costs.

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Appendix A: Survey Questions & Results

Part I

This is the list of questions and results from the survey done at the Loop Café inside of CIRS Building:

Questions
1. Have you tried the coffee in the Loop Café?
2. Do you usually add the liquid sugar provided in this café to your coffee?
3. Do you usually go back to Loop Café because the café provides liquid sugar?
4. Do you support UBC if it decided to provide liquid sugar pump to substitute the regular sugar packets at all cafés across campus?
5. Do you think liquid sugar is better than the regular sugar packets? If Yes, why do you prefer the liquid sugar?
Responses
1. 11 out of 11 people have tried the coffee at the Loop Café.
2. 11 out of 11 people usually add the liquid sugar provided to their coffee.
3. 8 out of 11 people are regulars at the Loop Cafe because the café provides liquid sugar instead of regular sugar packets.
4. 11 out of 11 people agreed to have liquid sugar pumps at all cafés around UBC.
5. 7 out of 11 people prefer liquid sugar over regular sugar packets, while the others could not taste any difference at all. Most people said that liquid sugar was better because it tasted sweeter, mixed/blended better, and did not give out “sandy” or granulated texture when the coffee is almost finished. Some people also said liquid sugar is not messy when added to their coffee.

Part II

This is the list of questions and results from the survey done at Café Perugia inside of Life Science Centre Building:

Questions
1. Are you familiar with liquid sugar?
2. If Yes, have you tried the liquid sugar? If No, would you try the liquid sugar?
3. UBC is always trying to be sustainable, therefore UBC is trying to change regular sugar packets to liquid sugar pumps in order to reduce the paper waste from the sugar packets. Do you agree with this change?
Responses
1. 7 out of 10 people are familiar with liquid sugar.
2. 7 out of 10 people have tried the liquid sugar and the other 3 people are willing to try the liquid sugar.

3. 10 out of 10 people would agree with UBC if it were to change from regular sugar packets to liquid sugar pumps.