

Bio-Based Dishwashing Liquid

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Abstract

Many conventional dishwashing liquids available in supermarkets may contain toxic ingredients hidden in the ingredients list. These toxic ingredients like phosphates and chlorine may get washed into water bodies and pollute the environment. Dishwashing liquid brands that claim that they are environmentally friendly may be just “greenwashing” their products. This could mean they include make environmental claims that may be truthful but unimportant. The dishwashing liquids available may not be safe for people and the environment. Hence, this project aims to create a truly environmentally friendly dishwashing liquid that is able to work effectively. The dishwashing liquid will biodegradable and contains mainly glucose and butanol. The dishwashing liquid was able to work effectively in emulsifying oils just like normal dishwashing liquids. The ratio of glucose to butanol should be 1:4 for the dishwashing liquid to work effectively. However, testing on the dishwashing liquid’s effect on skin required professional help in order to conclude if it will have any effect on the skin.

Introduction

Common dishwashing liquids that are readily available on the shelves of many supermarkets may contain toxic ingredients that can harm one’s health and the environments. 58 out of 232 dishwashing liquids listed on Environmental Working Group’s (EWG) Healthy Cleaning Database is known to include harmful ingredients. These include phosphates, triclosan, SLS (sodium lauryl sulfate)/SLES (sodium laureth sulfate) and chlorine. Phosphates they can deplete oxygen levels and promote the growth of certain algae which are toxic to consume. Triclosan, often referred to as the anti-bacterial and antifungal agent, is harmful to hormones and disrupts the body’s natural thyroid and endocrine systems. This chemical is also often attributed to the growth of “superbugs” since it bioaccumulates in the human body. SLS and SLES are surfactants that help remove the grime and grease on the dishes. However, they can absorb through the skin and lead to 1,4-dioxane contamination and had been known to also cause rashes and allergic reactions. Chlorine is extremely toxic for fish and may also be released into the air when washing the dishes.

More and more people are worried about the environment and their own health. This led to the growth of environmentally friendly dishwashing liquids in the market. More households are choosing these environmentally friendly dishwashing liquids over the regular dishwashing liquids because they are supposedly better for the environment and can work just like the regular liquids. However, these dishwashing liquids may still contain toxic ingredients hidden behind words like “Fragrances” and “Surfactant”. A report done by TerraChoice Group found that more than 95 percent of so-called green consumer products had committed at least one “greenwashing sin,” like making an environmental claim that may be truthful but unimportant. “CFC-Free” is common, since it is already banned by the law.

There are also simple recipes online for people to follow and make their own dishwashing liquid. These recipes often require ingredients like Sal Suds and borax. However, Sal Suds is very expensive and borax is a controlled substance in Singapore, which means it is not easy to get borax in Singapore for the average person. Furthermore, water with high mineral content (Hard Water) does not react well with DIY dishwashing liquids.

Hence, this project attempted to create a dishwashing liquid that is made from bio-based surfactants. This means that the dishwashing liquid would be environmentally friendly. The surfactant comprises of two main ingredients, glucose and butanol, both of which can be extracted from sugar beets, sugar cane, corn and coconut. The dishwashing liquid will be biodegradable and is not toxic to the environment or to one’s health.

Solution Design

The dishwashing liquids have three components to it. The surfactant, the anti-bacterial and antifungal agent, and water. The surfactant made was a sugar-based surfactant, Alkyl Polyglucoside (APG). The anti-bacterial and antifungal agent used was tea tree oil. Two different batches of the dishwashing liquid was made. One had the ratio of glucose to butanol at 1:4 and the other at 1:6.

Materials:

- Beakers
- Glucose solution (1.5mol/l)
- Butanol (74.12g/mol)
- Citric acid
- Tea tree oil
- Deionised water

Variables:

- Controlled variables:
 - Type of beakers
 - Amount of glucose solution used
 - Amount of tea tree oil used
 - Amount of deionised water added
 - Percentage of citric acid added in relation with butanol
- Independent variables:
 - Amount of butanol used
- Dependent variables:
 - Effectiveness of the dishwashing liquid at emulsifying and removing oil

Ingredients in the 1:4 batch: 10ml of glucose solution of 1.5 mol/l, 4.447g of butanol of 74.12g/mol, 0.13g (3% of the mass of butanol) of citric acid, 25ml of deionised water, 5ml of tea tree oil.

All the ingredients were added and mixed together to get a mixture with 2 layers of liquid.

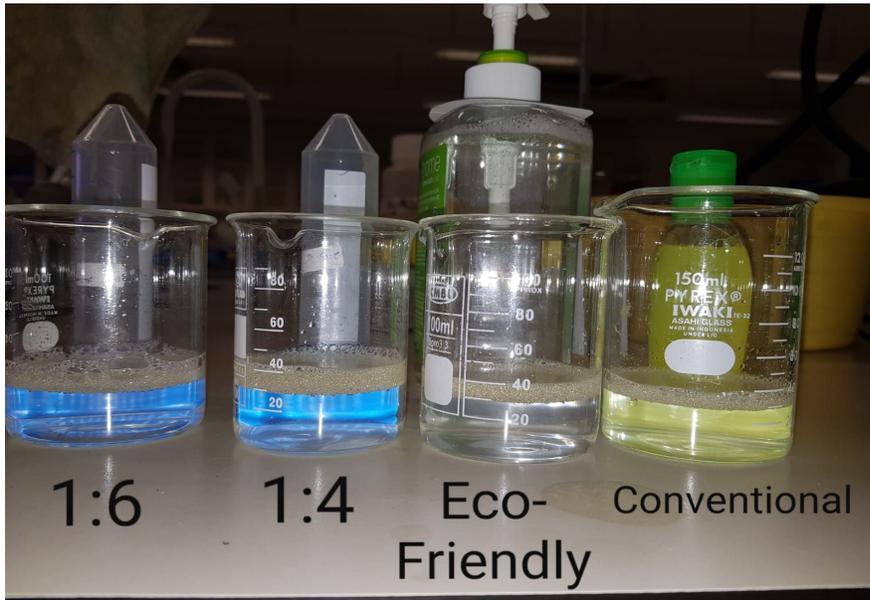
Ingredients in the 1:6 batch: 10ml of glucose solution of 1.5mol/l, 6.67g of butanol of 74.12g/mol, 0.20g (3% of the mass of butanol) of citric acid, 25ml of deionised water, 5ml of tea tree oil.

All the ingredients were added and mixed together to get a mixture with 2 layers of liquid.

Method:

An emulsification test was conducted to test the effectiveness of the dishwashing liquids made. 30ml of deionised water and 10ml of corn oil was added into the two beakers. Since the dishwashing liquid is not yet homogenous, it has to be shaken to thoroughly mix the layers of liquid together before use. 2ml of each batch of dishwashing liquid was added to each of the two beakers containing the oil and water. Liquids in both beakers were mixed slowly to prevent the mixture to form bubbles in order to get better readings. Similar concentrations of dishwashing liquid from conventional store-bought dishwashing liquids were added into two other beakers with the same amounts of water and oil. They were also mixed slowly to prevent bubbles from forming. The oils in each of the beaker would be compared against each other to find out the more effective ratio of glucose to butanol to add in the dishwashing liquid. Then, the dishwashing liquids made would be compared against regular ones that can be easily found in supermarkets.

Results and Discussion



The beaker on the extreme left contains the 1:6 batch of the dishwashing liquid

The beaker second from the left contains the 1:4 batch of the dishwashing liquid

The third beaker from the left contains the store-bought environmentally friendly dishwashing liquid

The beaker on the extreme right contains the conventional dishwashing liquid



The 1:4 batch had good results, it was comparable to the eco-friendly dishwashing liquid. The 1:6 batch did the poorest job at emulsifying the oil amongst the 4 dishwashing liquids. The oil

globules in that beaker was the largest. The oil globule in the beaker with the 1:4 batch of dishwashing liquid was slightly bigger than the eco-friendly dishwashing liquid. The conventional dishwashing liquid had the best results. The oil globules in the beaker was the smallest.

Conclusion

As observed from the above results, the dishwashing liquid works better with a ratio of glucose to butanol at 1:4. The dishwashing liquid does not require for extremely hard to get ingredients and all ingredients used is biodegradable. It could work quite as effectively, although when compared to the commercially available dishwashing liquids, it definitely does not perform better. However, the commercially available dishwashing liquid indeed loses to the bio-based dishwashing liquid made in terms of environmental profile. The bio-based dishwashing liquid does not pollute the environment. The limitations of this project is that it is hard to study the effects this dishwashing liquid has on skin. Professional help is needed to conclude if it has any effect on skin.

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