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Formulation and Evaluation of Non-Synthetic, Moisturizing, Antibacterial & Vegan Liquid Hand-Wash

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Abstract

Liquid Hand-Wash was been introduced to help in the thorough and proper cleaning of our Hands and keep them clean & safe. It is a Skincare or Cosmetic Product that does not contain any amounts of synthetic ingredients (chemical-based ingredients) instead has naturally derived ingredients. The Non-Synthetic formulations are not at all harsh on the skin. A product labelled as "Non-Synthetic" contains no man-made ingredients to speak of its 100% made of naturally occurring elements or compounds. Lauryl Glucoside is commonly used as a cleansing and foaming agent in cosmetics and shampoos as a safer alternative to lauryl sulphates, formaldehyde, and diethanolamides. Coco-glucoside and Lauryl Glucoside are completely naturally derived and biodegradable. The formulated Non-Synthetic liquid hand-wash is found to be safe and very much effective in cleansing as well as moisturizing aspect.

Keywords: Non-Synthetic, Hand-Wash, Moisturizing, Antibacterial, Vegan.

1. Introduction

The hands are the most prominent parts of the human body. We conduct our daily physical work with the help of our hands, which come in contact with several things in our surroundings. This may contaminate our hands with several bacteria or toxic substances. Here comes the most important and needful role of personal hygiene by washing our hands properly and thoroughly.

Liquid hand-wash was been introduced to help in the thorough and proper cleaning of our hands and keep them clean & safe so that they won't contribute to the spreading of diseases or get you diseased with certain gastrointestinal or respiratory disorders.

In the pharmaceutical industry, various types of liquid hand-washes are available like natural/herbal hand-washes & regular synthetic hand-washes with several other features. Among these, regular synthetic hand-washes are used on a large number which contains SLS (sodium lauryl sulphate), SLES (sodium laureth sulphate), and many other chemicals which are cheaper ingredients in the industry and that's the reason why those hand-washes are cheaper and people use those more. Such ingredients present in the synthetic hand-wash may irritate or penetrate the skin or may be toxic to the skin.

In this growing cosmetic industry, people have started developing their interest in skincare along with personal hygiene. Therefore, natural products have a major scope in the ongoing & upcoming years.

Hereby we introduce **"non-synthetic liquid hand-wash."** It is a skincare or cosmetic product that does not contain any amounts of synthetic ingredients (chemical-based ingredients), instead has naturally derived ingredients. The non-synthetic formulations for skincare are not at all harsh on the skin.

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Important Terms:

1. Synthetic Formulation:

A synthetic is a substance which has been formulated or manufactured by chemical process and has chemically altered substances which was derived from a naturally occurring plant, mineral or animal source.

2. Non-Synthetic Formulation:

A product labeled as **"Non-Synthetic"** contains no man-made ingredients to speak of its 100% made of naturally occurring elements or compounds. The term "plant-based" might be a little more flexible but generally indicates that the product is made with botanical ingredients which is generally termed as "Herbal". But "Non-Synthetic" and "Herbal" are two different terms and can't be referred to each other. Hence, non-synthetic formulation is a separate stream of natural formulations.

3. Vegan Formulation:

A product labeled **"Vegan"** contains no animal products or byproducts. [1]

Ingredients:

1. Coco-Glucoside:

Coco-Glucoside is a non-ionic, hazy viscous liquid (2000 cps at 75°F; crystallizes at 60°F) that is naturally generated and has strong water solubility due to its hydroxyl groups. It is made up of plant sugars and fatty alcohols and is much gentler than typical anionic surfactants. In liquid cleansers and shampoos, it functions as a foaming, cleansing, conditioning, and viscosity-building agent. It's also **biodegradable** and environmental friendly, and its structure is similar to glycolipids and other biological surfactants.
Coco-Glucoside is an emulsifying agent that is free of sulphates, parabens, and other potentially hazardous chemicals.
Coco-Glucosides are commonly used as cleansing and foaming agents in a variety of cosmetics and shampoos as a safer alternative to lauryl sulphates, formaldehyde, and diethanolamides. [2]

2. Lauryl Glucoside:

Surfactant lauryl glucoside is derived from natural sources. It's a foaming agent that not only produces a great lather but also works as a cleanser.
Lauryl Glucoside is not only gentle on skin and hair, but it is also **biodegradable**. This means it decomposes quickly in nature and does not pollute the environment.
Lauryl Glucoside is made by mixing sugar from a natural source, such as corn, with a fatty alcohol. Palm oil, Coconut oil, and other oils provide the majority of the fatty alcohol.
Petrochemicals can also be used to generate less expensive variants of fatty alcohol. Check the label to see if the lauryl glucoside is vegan or natural.
Lauryl Glucoside is a very mild surfactant that does not cause irritation to your skin. That is why it is found in skincare products aimed at those with sensitive skin.
Lauryl Glucoside is considered a safe component by a number of organizations, including the Safe Cosmetics Database, Good Guide Database, EcoCert, and the Organic Food Federation. It's even on the CIR's list of Cosmetics' safe ingredients. [3]

3. Vegetable Glycerin:

Vegetable Glycerin is a clear, odorless and sweet-tasting liquid derived from vegetable fats. It is added to food, cosmetics and pharmaceuticals and may offer skin health benefits, such as moisturized and resilient skin, improved hydration of the skin.

4. Avocado Oil:

Avocado Oil is a carrier oil obtained from the pulp of avocados, a Persea Americana fruit.
Avocado Oil is high in beta carotene, protein, lecithin, fatty acids, and vitamins A, D, and E, which serve to moisturize and protect your skin.

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The antioxidants and anti-inflammatory components in avocado oil keeps your skin smooth, healthy, and elastic. The main advantages of avocado oil are as follows: soothe itchy skin, cure chapped skin, replenish dry skin, hydrate and moisturize skin, sheild skin from UV radiation, guard against skin damage.

5. Xanthan Gum:

To keep ingredients from separating, xanthan gum is used as a stabilizer and a thickening agent.
Xanthan Gum, although not an active ingredient, has a significant role in the texture and formulation of skincare products.

6. Optiphen Plus:

Optiphen is a completely natural preservative and optiphen plus is a combination of optiphen with a trace of sorbic acid to give further protection against mould and germs.
Sorbic acid, which was originally derived from berries of the mountain ash tree, has been manufactured commercially since 1954. Sorbic acid, an unsaturated fatty acid, and its salts have been proven to be efficient antibacterial agents and are thus widely used in food, cosmetic and pharmaceutical preservation. The undissosiated acid molecule is responsible for the inhibitory action of sorbic acid and its salts. As a result, the action is pH dependent; making it suited for mildly acidic personal care products with a pH less than 6.0. It can also be used selectively in formulations with pH levels higher than 6.0.
Sorbic acid and phenoxyethanol work together to provide broad spectrum preservation against gram-positive and gram-negative bacteria, yeast, and mould. [4]

2. Material & Methods

List of ingredients used:

- Coco-Glucoside
- Lauryl Glucoside
- Vegetable Glycerin
- Avocado Oil
- Xanthan Gum
- Optiphen Plus

Two phases were prepared while formulating the non-synthetic liquid hand-wash, phase A & B. Phase A consisted of moisturizing agents with distilled water and then Phase B ingredients were added to Phase A ingredients which consisted of surfactants, thickening agent, preservative and were blended thoroughly without letting the formation of foam due to high RPM of the lab stirrer. The RPM of the lab stirrer need to be mainted in a medium range of 500-800; so that blending is done without formation of foam. You can also add natural fragrance & natural color to the formulation.

pH Value:

The pH value plays a most role in the cosmetics as the product is intended to be in contact with the skin while its use. So, pH value is needed to be measured / checked.
The pH value of the non-synthetic hand-wash is obtained / calculated by a digital pH meter (Equip-Tronics digital pH meter model EQ-610).

Texture Analysis:

The texture analysis was carried out with the help of Brookfield Texture Analyzer at the AISSMS College Of Pharmacy, Pune-411001, Maharashtra, India.
Complete mechanical characterization of non-synthetic liquid hand-wash was carried out using Texture analyser (CT3 Brookfield Engineering, USA) with a load cell of 1000g. Non-synthetic liquid hand-wash was placed in the cone of spread test fixture and allowed to set at room temperature for 30 min. The excess formulation was scrapped off from the cone holder to get a smooth and flat surface for the analysis to avoid early trigger for the test. The probe (TA2/1000) was programmed in Texture Profile Analysis mode, to move

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into the hand-wash with a pre-test speed 2 mm/s and test-speed of 2 mm/s and was moved out of gel at return speed of 2 mm/s.
The data was collected and analysed using software TexturePro CT V1.7 Build 29 to determine parameters such as hardness, extrudability, spreadability, adhesiveness, and springiness with two cycles of compression & decompression. [5]
The force-time texture profile graph of non-synthetic liquid hand-wash with two cycles of compression and decompression is shown in Figure no. 2.

Foaming Ability Test:
This Procedure is used to determine the foaming ability of the solutions. 50 ml graduated cylinder with a glass-stoppered top. The graduated cylinder should have volume markings for more accurate measurements.
Take 10 ml of freshly prepared Liquid Hand-Wash into the graduated cylinder. Add 10 ml of water to the solution to it. Insert the glass stopper into the cylinder. Agitate the solution by shaking the cylinder vertically, as vigorously as possible, for 10 seconds, while holding the stopper down with one finger. As soon as shaking is finished, note the total volume of the foam in the cylinder. If the level is uneven, estimate the average volume. Calculate the foam expansion using equation-1. [6]

Viscosity Analysis:
Viscosity of the non-synthetic liquid hand-wash was carried out by Brookfield Viscometer DV-III Ultra. Various readings were taken at different RPM and with different spindles. Correct spindle must be identified and used to get correct reading and a torque more than 10%. Which will give a stable and more accurate reading. If the reading is below 10% at least 3 speeds, then you need to change the spindle.
The viscosity analysis was carried out with the help of Brookfield Viscometer, with spindle no. 06 attached to it. The viscosity of the liquid hand-wash should lie within the range of 1000-3500 cps (centipoises). [7]

Rhoelogical Analysis:
Rheology is the study of flow or plastic or plastic deformation properties of a fluid in relation to shear forces such as rational torque.
The spreadability of the sample non-synthetic liquid hand-wash can be determined by its rheological manner.
Measure the viscosity of the non-synthetic hand-wash at different RPMs. From less RPM to high RPM. If the viscosity of the non-synthetic liquid hand-wash decreases on the increase in the RPM of the viscometer that indicate the hand wash having shear thinning property, which is more useful in case of hand wash during storage, removal of hand wash from container and during application with good spreadability.
This analysis is carried out by a Brookfield Viscometer / Rheometer DV-III Ultra.

Antibacterial test using finger punch method:
This Procedure is carried out by wearing Sterile Surgical Gloves. Other than that, Petri plates, nutrient agar, burners, pipette, rubber bulb & E.Coli is required for this test.
Prepare sufficient nutrient agar. Sterilize Petri plates and nutrient agar in the autoclave. Prepare a sterilized area in the lab between two burners (flammed) and clean the surface between the burners with alcohol before turning the burners on. Take the sterilized Petri plates and fill those with the nutrient agar in the sterile area prepared in the lab. Let the nutrient agar solidify. Label the Petri plates as (1) Sterile hand-gloves, (2) Contaminated hand-gloves (before hand-wash), (3) Washed hand-gloves (after hand-wash). Wear sterile surgical hand-gloves properly and see that those don't get contaminated. Punch the fingers of sterile hand-gloves in Petri plate (1) to ensure that no bacteria/germs are present on the hand-gloves. Take a little amount of E.Coli with the help of pipette and apply it on the hand-gloves. Specially on the fingers. Punch the fingers of contaminated hand-gloves with E.Coli in Petri plate (2). Wash the hands wearing the hand-gloves with the non-synthetic liquid hand-wash which has to be tested properly. Let the hand-gloves dry. Punch the washed hand-glove fingers in Petri plate (3). Keep the Petri plates in the incubator for 24 Hours & observe the results after 24 hours. [8]

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Stability Test:
Stability study was performed as per ICH guidelines Q1A (R2) for the optimized batch to determine the effect of presence of formulation additives on the stability of the drug and also to determine the physical stability of the formulation under accelerated storage conditions. The optimized batch was subjected to elevated temperature and humidity conditions of (30 ± 2°C / 65% RH). Hand-wash sample was withdrawn at the end of 0, 30, 60 and 90 days and evaluated for active ingredient content, appearance, pH, texture. [9]

3. Results & Discussion

pH Value:
The pH of final formulation was observed to be in the range of 5.7 to 6.3 and which was near to the physiological pH of the skin. Hence it was concluded that the hand-wash formulation was safe to use topically. [10]

Texture Analysis:
The hardness of the formulation defines its main texture on the basis of application on skin. Adhesiveness of the formulation defines the adhesiveness of the ingredients that bind together by the adhesive force. Springiness index is the index of the elastic behavior of the hand-wash sample.

Foaming Ability Test:
The initial volume after adding 10 ml of non-synthetic liquid hand-wash and 10 ml of water into the graduated cylinder is 20 ml. Later after agitating the solution by vigorously shaking the cylinder, formation of foam is seen. The final volume was found to be increased by almost 10 ml.

Foam Expansion = 0.5

Therefore, there was 10 ml foam observed, and a foam expansion of 0.5.

Viscosity Analysis:
The obtained viscosity of the sample is 2740 cP (centipoises)

Rheological Analysis:
One more criteria of evaluation was carried out under viscosity analysis, under which viscosity at different speeds was measured and it was found that viscosity decreases on increase in RPM. This indicated a good spreadability of the non-synthetic hand-wash when used while washing of hands.

Antibacterial test using finger punch method:
Following are the results observed after 24 hours of performing the test: (Shown in Figure no. 3)

The results show that the following sample of Non-Synthetic Liquid Hand-Wash showed 99.99% effectiveness in the antibacterial activity.
To compare the following results of antibacterial activity of the sample Hand-Wash, the same procedure was followed for only water wash of Hand-Gloves. (Shown in Figure no. 4)

This shows that, only water wash of hands shows no effectiveness over the antibacterial activity as there is the same amount of bacterial growth in after washing Petri plate of water wash only.

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Stability Test:
After performing the stability test in the stability chamber, all the properties such as appearance, viscosity, pH & texture were checked again. Hence, it is found that there are no changes in the non-synthetic hand-wash and the formulation is said to be stable.

4. Conclusion

This research was conducted to introduce "Non-Synthetic" as a separate new stream in the cosmetics and the effectiveness of the formulated non-synthetic liquid hand-wash. From all the evaluation parameters it can be said that the sample of non-synthetic liquid hand-wash on which the research is based, is completely formulated with natural ingredients which are derived from the natural sources. It has moisturizing effect due to moisturizing agents like vegetable glycerin & avocado oil in the formulation. It is also 99.99% effective in the antibacterial activity which will keep the hands of an individual clean and maintain personal hygiene. The moisturizing effect will keep the hands soft and moisturized & the antibacterial activity will keep the hands clean and safe. The formulated product of non-synthetic liquid hand-wash does not contain any kind of animal products or animal byproducts and is not involved in any kind of animal activity, therefore, it can be said that the formulated non-synthetic liquid hand-wash is also vegan. It has a proper level of pH as that of normal skin pH range and also has proper viscosity. It also satisfied the stability test. Hence, all the evaluation parameters can be said to be qualified and satisfied.

5. Tables, Figures and Equations

5.1 Tables

Table no. 1: Evaluation parameters of texture analysis.

Sr. No.	Evaluation Parameter	Value	Unit
1	Hardness (Cycle 1)	54.40	G
2	Adhesive Force	16.70	G
3	Adhesiveness	1.32	mJ
4	Springiness Index	1.00	

Table no. 2: Volume of sample & water for foaming ability test.

Sr. No.	Activity	Volume
1	Adding the sample (Non-Synthetic Liquid Hand-Wash)	10 ml
2	Adding water	10 ml
3	Foam observed After shaking vigorously	10 ml

Table no. 3: Viscosity determination of non-synthetic liquid hand-wash at various RPM.

Sr. no.	RPM	Viscosity
1	50	2740 cP
2	100	2320 cP
3	150	1840 cP
4	200	1500 cP

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Table no. 4: Parameters checked after stability test.

Months	Temperature	Appearance	Viscosity	pH	Texture
1st month	30 ± 2°C / 65 ± 5	No change	2740 cP	5.7-6.3	No change
2nd month	30 ± 2°C / 65 ± 5	No change	2742 cP	5.7-6.3	No change
3rd month	30 ± 2°C / 65 ± 5	No change	2741 cP	5.7-6.3	No change

5.2 Figures

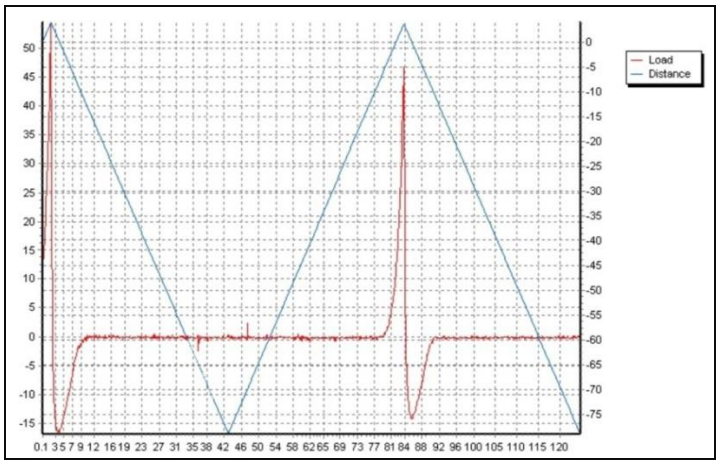

Figure no. 1: Graph of Texture Analysis

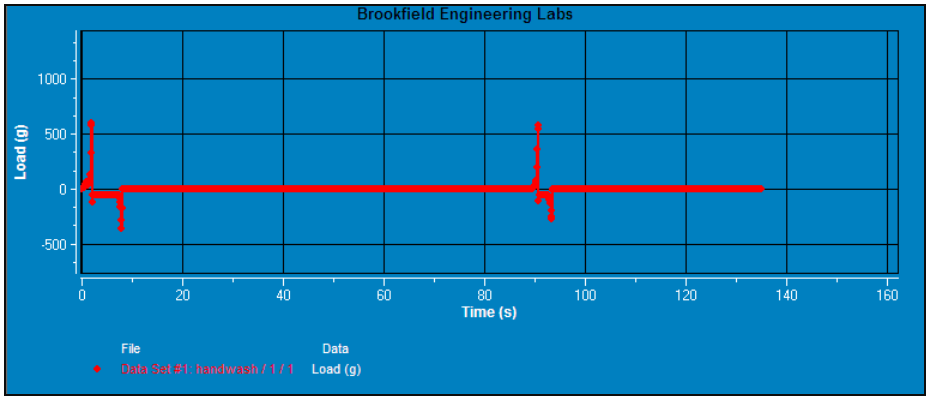

Figure no. 2: Force-time texture profile of non-synthetic liquid hand-wash

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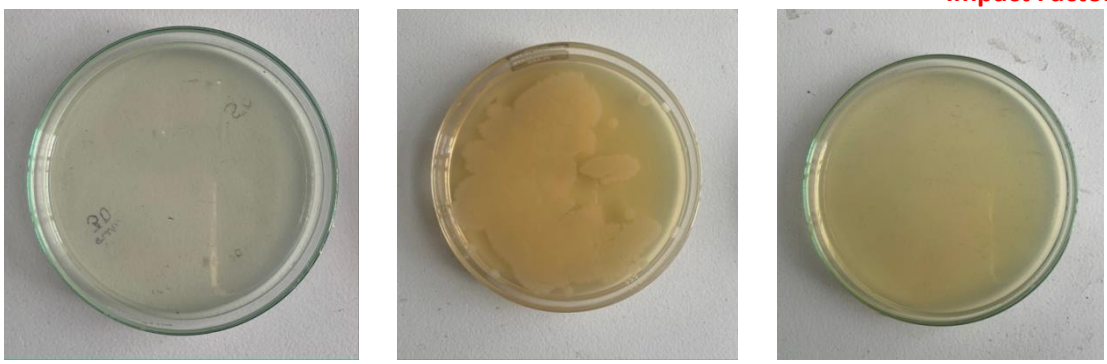
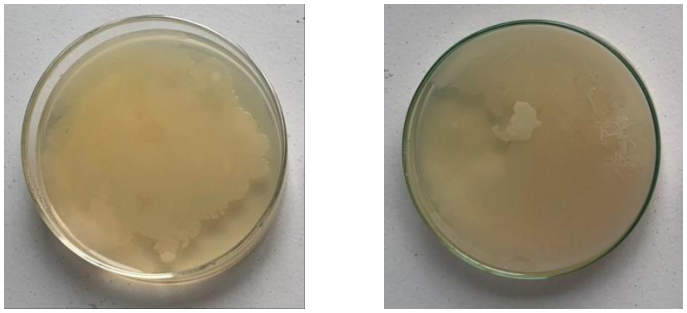


(i) (ii) (iii)

Figure no. 3: (i) Punch of sterile hand-gloves to ensure the sterility. (ii) Punch of contaminated hand-gloves with E.Coli. (iii) Punch of washed hand-gloves with sample hand-wash.



(i) (ii)

Figure no. 4: (i) Punch of contaminated hand-gloves before washing with water. (ii) Punch of hand-gloves after washing with water only.

5.3 Equation

$$\text{Foam Expansion} = \frac{\text{Volume of Foam}}{\text{Volume of Solution}} \qquad (1)$$

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A Brief Author Biography

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