USE, TREATMENT AND RECOVERY OF RESIDUAL FRYING OILS: A PRACTICAL APPROACH

10.56238/edimpacto2025.025-001

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ABSTRACT
The growing concern about the environmental impact of human activities, such as the improper disposal of cooking oil, motivates the search for sustainable solutions, such as the production of biodiesel and soaps. Chemistry teaching can be enriched with practical activities that integrate theory and practice, promoting learning and critical thinking. School laboratories, which are essential for the development of these activities, must follow strict safety standards to ensure a safe and efficient environment. In addition, it is essential that students and teachers are trained in safety standards to avoid accidents. Awareness of these practices contributes to academic training and environmental preservation.

Keywords: Cooking oil. Safety standards.

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INTRODUCTION

The growing concern about the impacts of human activities on natural resources has encouraged the search for efficient methods of waste treatment. Among these wastes is used cooking oil, which represents an efficient source of environmental damage. This oil, when no longer suitable for frying, is often improperly disposed of in sewage systems, on the ground, or sent to landfills. To mitigate the environmental impacts caused by this irregular disposal, there are several technologies available to minimize, such as biodiesel production, enzyme treatment, and bar soap production. All these technologies can be taught to young students from high school, with the adoption of, for example, practical classes (Mulinari *et al.*, 2016).

Experimental activities play a fundamental role in the teaching of Chemistry, providing numerous benefits that improve the learning experience of students, and one of the benefits of these activities is to expand practical and cognitive skills. During the experiments, students are encouraged to practice, observe, collect data and interpret results. These skills are more useful not only for Chemistry, but also for various areas of our experience, such as solving everyday problems and critical thinking (Neto *et al*., 2024).

Laboratory classes emerge as more appropriate methodological possibilities to reduce the distance between scientific knowledge and common sense, in a more consensual and dynamic way (Krasilchik, 2005).

In this way, the experiments contribute to making the abstract concepts of Chemistry more visible. Students have the opportunity to visualize, handle, and interact with chemical substances and reactions, making learning more palpable and accessible. Presented the relevance of the adoption of these practical activities for the Teaching of Chemistry, especially when discussing environmental issues and preservation of the environment, considering the problem of incorrect disposal of used cooking oil, it is proposed in this material three options for a better disposal of used oil will be presented. The scripts, in addition to presenting a solution and a correct destination of these products, aim at their reproduction in school environments, using school laboratories.

To this end, it is necessary to present, before the practical itineraries, the importance of Science Laboratories in Schools, highlighting the safety issue of the enclosure, as well as the materials that are commonly used for the activities.

THE SCIENCE LABORATORY: A SPACE WITH POTENTIAL THAT REQUIRES ATTENTION TO SAFETY STANDARDS

In short, the science lab can be seen as a hands-on learning environment that sparks curiosity, promotes critical thinking, and provides unique opportunities for scientific inquiry. It allows students and researchers to explore natural phenomena, test hypotheses, and develop skills that are essential for the advancement of knowledge.

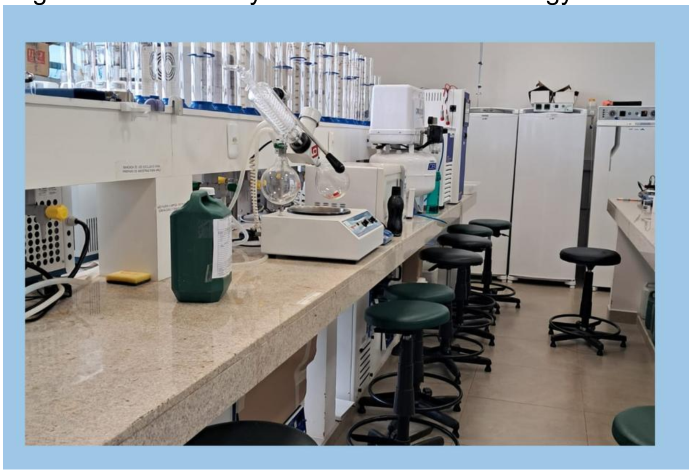
According to Garcia *et al.* (2018), school laboratories play a crucial role in the teaching-learning process, as they stimulate scientific curiosity and students' autonomy. In addition, as Silva and Oliveira (2020) point out, practical activities favor interdisciplinarity and teamwork, essential skills for academic and professional training.

However, the activities carried out in this space, due to their experimental nature, involve the use of chemical and biological materials and equipment that may present safety risks. Therefore, in addition to being a place rich in pedagogical potential, the laboratory requires strict attention to safety standards, to ensure a safe and productive environment for all its users. In this text, we advance in presenting the functionalities of a laboratory, as well as exploring the importance of the laboratory as a learning space, highlighting the need for safe practices and the role of standards in preventing accidents and preserving the physical and mental integrity of those involved. Also, in this section it is intended to present a list of the main materials that are used in these spaces.

WHAT IS THE FUNCTIONALITY OF A SCIENCE LABORATORY?

The Science Laboratory is a space designed to carry out experiments, observations, investigations and analyses related to different areas of science, such as biology, chemistry, physics, geology and other disciplines. In schools and universities, laboratories help students understand theoretical concepts through practice. Figure 1 shows the standard organization of a laboratory bench.

Figure 1: Image of the laboratory bench of the Microbiology Laboratory – UFFS.



Source: The authors.

Thus, this place plays a key role in education and research, offering a practical space to explore, experiment and understand scientific concepts, being used so that students can apply theory in practice, testing concepts and formulating hypotheses. Given its relevance to the teaching and learning process in formal and non-formal spaces of Brazilian education, it is necessary to pay attention to the safety standards of these spaces, which are discussed below.

BASIC SAFETY STANDARDS IN THE LABORATORY

It should be noted that the Laboratory environment is not a dangerous workspace, but requires that all those involved in the activities can act with prudence to ensure their safety. Lack of attention or lack of knowledge about possible risks can result in accidents. Therefore, it is essential to know the safety procedures before starting any activity in the laboratory, thus ensuring that you perform with the lowest possible risk.

According to Andrade and Santos (2019), safety awareness in the laboratory should be an integral part of teaching, involving everything from the planning of practical classes to the training of students and teachers. In addition, Souza *et al*. (2021) highlight that the application of biosafety standards and the proper maintenance of equipment significantly reduce the risk of accidents, promoting a safer and more conducive environment for learning.

Initially, the use of the laboratory requires compliance with safety standards, such as the use of personal protective equipment (goggles, gloves, lab coat) and procedures for the correct handling of hazardous substances. In figure 2, we present a summary of the basic safety standards in a laboratory.

Figure 2: Basic standards for safety in laboratories.

Source: The authors.

Safety standards in laboratories are not just mandatory procedures, but a commitment to the preservation of life, health and the environment. They ensure that experimental activities can be carried out safely and efficiently, protecting everyone involved from potential risks. Compliance with these standards should be an integral part of any laboratory's culture, reinforcing collective and individual responsibility. Thus, by adopting safe practices, not only the integrity of the workspace is ensured, but also the continuity of learning, research and innovation in an ethical and responsible manner. Safety in the laboratory is more than a rule; It is an essential pillar for sustainable scientific progress.

Safety symbols in a laboratory.

Within laboratories, there are safety symbols that are standardized icons that indicate potential hazards associated with substances, equipment, or conditions in a laboratory environment. These symbols help to alert users to take precautions and ensure safe work, and, according to Souza and Ferreira (2019), the correct interpretation of these symbols contributes to users' awareness of the risks present in the laboratory environment and to compliance with safety standards. Figure 3 presents some of the main symbols and their meanings.

The visual representations presented above are relevant for the user of the space to be aware of possible dangers, in addition to providing safety guidelines and helping to prevent accidents.

In short, it can be said that safety symbols are indispensable allies to promote a safe and efficient work environment, protecting not only people, but also materials and the laboratory itself from damage. Their presence and correct interpretation are essential to ensure the success of scientific activities in a responsible and safe manner. Knowing them is essential for safe work in the laboratory environment, as well as knowing materials and equipment that are used in these spaces, which are presented below.

LABORATORY MATERIALS AND EQUIPMENT

Laboratory materials and equipment vary according to the scientific area (chemistry, biology, physics, etc.), but there are common and essential items for conducting experiments and analyses. These are essential for carrying out experiments and practical activities safely and accurately. They can be classified according to their function, such as measuring, containing, heating, mixing, or observing substances. Among the materials in common use, beakers, test tubes, beakers and pipettes stand out, which are used for handling and transferring liquids.

The equipment includes tools such as the Bunsen burner, used for heating; centrifuges, for separating mixtures; and microscopes, for analyzing samples on a microscopic scale. In addition, there is protective equipment, such as gloves, safety goggles and lab coats, which are essential for the protection of the user as mentioned earlier.

Each material or equipment has specific characteristics that must be understood before use, ensuring the efficiency of the experiment and safety in the laboratory environment. It is important to highlight that the correct use of the instruments available in laboratories is essential to ensure the reliability of the results and avoid experimental errors (COSTA and RIBEIRO, 2020).

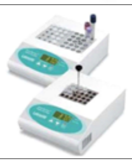
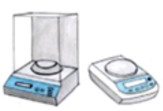
Thus, Table 1 is presented, showing the name and function of the laboratory glassware as well as an image of each one.

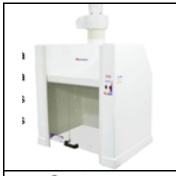
Figure 3: Symbology present in the Laboratories and their meanings.

Source: The authors.

Table 1: Image with name and function of laboratory glassware.

	*Beaker*: used to dilute, heat and prepare solutions, helping in the preparation of reactions.
	*Cylinder Tube*: Also called graduated cylinder, it is used for approximate measurements of liquid volumes.

	*Graduated pipette*: Used to measure and transfer small, accurate volumes of liquids.
	*Volumetric pipette:* It is used to measure and transfer small volumes of liquids in an accurate manner.
	*Pasteur pipette:* It is used constantly as a dropper or to measure and transfer small volumes of liquids. It is not recommended for measuring accurate volumes.
	*Erlenmeyer:* Cone-shaped flask is used to mix solutions, prevent spills, and perform reactions.
	*Test tube:* Small cylindrical containers for small-scale chemical reactions.
	*Burette*: It is used to perform accurate volumetric measurements, usually used in titrations.
	*Separation hopper:* used to separate immiscible liquids.
	*Bunsen burner*: It is a source of flame, used to heat substances.
	*Magnetic stirrer with heating or Heating plate*: It is used to heat solutions in flat containers and to homogenize solutions using a magnetic bar
	*Dry bath (digester block):* This equipment does not use water to heat the containers with the products, allowing homogeneous heating of the containers.
	*Analytical balance*: It is used to measure masses with high accuracy.
	*pH meter*: Used to measure the acidity or alkalinity of solutions.

	*Exhaust hood:* Used to prevent the inhalation of toxic gases during the handling of chemical substances
	*Microscope*: Equipment that magnifies images to study small organisms or structures that are not possible to be seen with the naked eye.
	*Pisseta*: It is used to conserve liquids in washing processes
	*Spectrophotometer*: It is used in the reading of samples in order to analyze the amount of light aggregated or conducted by the substance.
	*Water bath*: Used to heat substances when they cannot be continuously brought to the fire.
	*Desiccant*: Used in the packaging of substances that should have a low humidity index.
	*Analytical funnel:* Use for transferring liquids between containers.
	*Büchner Funnel:* It is used together with Kitasato for vacuum filtration.
	*Kitasate*: As mentioned above, it is used for vacuum filtration processes.
	*Round-bottomed balloon*: Mainly used in rotary evaporation systems and for heating in heating blanket.
	*Flat-bottomed balloon*: It is used to contain liquids or solutions, it can be heated and supported on a flat surface.
	*Volumetric flask*: Used to create solutions and accurately estimate a fixed volume, it should not be placed in a sterilization and drying oven because, in case of heating, the glassware may lose its precision.

Source: Adapted by the authors from Pereira et al., 2020.

Knowing the materials and equipment in a laboratory is essential to ensure the safe, efficient, and accurate performance of scientific experiments and activities. This knowledge allows users to handle the appropriate resources for each procedure, understand their functionalities and limitations, and take appropriate precautions to avoid damage to the equipment, the environment, and themselves.

In addition, mastery of instruments and materials fosters confidence, autonomy and the ability to solve problems, fundamental factors for academic and professional advancement. Thus, familiarity with the laboratory environment is not only a technical requirement, but also an indispensable basis for scientific excellence, the development of creativity and the promotion of a culture of safety and responsibility.

By knowing the basic safety guidelines in the Laboratory, as well as the materials that are used with their functionalities, it follows by presenting three scripts of practical activities that can be a solution to face the incorrect disposal of used cooking oil: initially the enzymatic treatment, then the production of biodiesel and also the production of soap.

In order to have a possibility in the face of the problem of irregular disposal of frying oil, it is possible to recycle this residual oil and transform it into biodiesel or soap, reducing its environmental impacts and contributing to the circular economy (Rodrigues *et al.*, 2021), or even, carrying out the enzymatic treatment of this waste.

The three routes, in addition to being relevant when we think about the environmental issues surrounding the incorrect disposal of cooking oil, which are often thrown down the sink drain, reaching the sewage networks and even water sources in Brazilian cities, can contribute to obtaining a product with greater added value, in addition to making Science Teaching more practical.

ENZYMATIC TREATMENT OF FRYING WASTE OIL

The enzymatic hydrolysis of oils can be used as a pre-treatment of these residues, with the purpose of improving their extraction capacity and speeding up the decomposition technique, and the hydrolysis products are quickly consumed by the semipermeable plasma membrane of the microorganisms, being able to generate a lipid-free environment. Lipases point to a high potential to be used in the food and pharmaceutical industry, biofuel production, and treatment of petroleum-containing wastewater. However, the use of these enzymes is limited by the high cost of commercial lipases. In this sense, the production of lipase by microorganisms using agro-industrial by-products as substrate is essential for lowering the costs of the process and presents the same result as the commercial enzyme (Mulinari *et al.*, 2016)element.

The treatment of vegetable oil with non-commercial enzymes can improve the quality of the oil, aiming at the deterioration of unwanted compounds and the transformation of the physicochemical properties of the oil. They break down molecules that are responsible for undesirable smells contained in vegetable oil, making it odorless, recovering flavor and aroma to be more suitable for consumption. They are also able to remove impurities and substances that generate a matte color to the oil, helping to achieve a clearer and pleasant-looking final product (Mulinari *et al.*, 2016)element.

In addition, enzymes can help in the hydrolysis of lipids for the release of fatty acids and glycerol, which can be harnessed in other applications, such as the production of biodiesel or other value-added products. When lipases dissolved in water, they catalyze the ester bonds of triglycerides, allowing them to transform their way of acting in an organic environment, so that esterification and interesterification reactions can be propagated to obtain products of industrial interest in the oil and fat sector (Castro *et al.*, 2003)element.

This process, using non-commercial enzymes, can be more economical and environmentally friendly, avoiding the use of industrial chemicals. In this sense, we use non-commercial, laboratory-produced enzymes to lower costs.

PROCEDURE FOR ENZYMATIC TREATMENT

Enzymatic treatment has been widely used in several areas of biotechnology, including the food, pharmaceutical and environmental industries, due to its specificity, efficiency and lower environmental impact compared to conventional chemical processes (Chaplin & Bucke, 1990). Enzymes are biological catalysts that accelerate chemical reactions by promoting the conversion of specific substrates into desired products under controlled conditions.

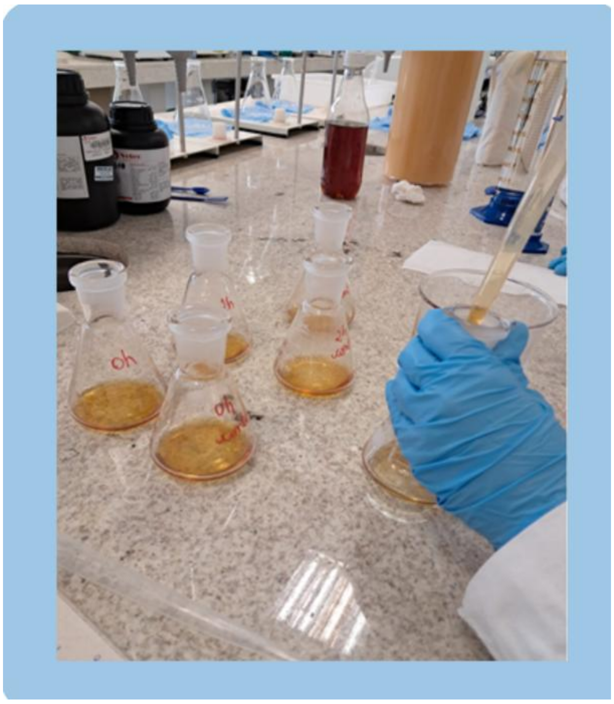
The application of enzymes in the treatment of biological materials requires the standardization of a procedure that ensures optimal enzymatic activity, considering factors such as temperature, pH, reaction time, and enzyme concentration (Bisswanger, 2014). In addition, the choice of the appropriate enzyme and the optimization of reaction conditions are key to ensuring process efficiency and stability of the final products.

The following script presents a detailed procedure for enzymatic treatment, covering everything from substrate preparation to process completion, based on scientific protocols and guidelines established in the literature. The objective is to provide a technical and practical guide for the application of enzymes in different laboratory and industrial contexts.

Sample 1

- Add 10 mL of waste oil to an Erlenmeyer flask;
- Then proceed with the addition of 300 mL of water and 6 mL of an enzyme of non-commercial origin.

Figure 4: Beginning of the practical activity, separation phase of the oily fraction, related to the enzymatic treatment for samples 1 and 2.



Source: The authors

Figure 5: Introduction of an enzyme of non-commercial origin.

Source: The authors

Sample 2 – control

- Add 10 mL of used oil to an Erlenmeyer;
- Follow with the addition of 36 mL of water.

For the two samples

- Remove 10 mL from samples 1 and 2;
- Add 10 mL of a solution containing acetone and ethanol to each.

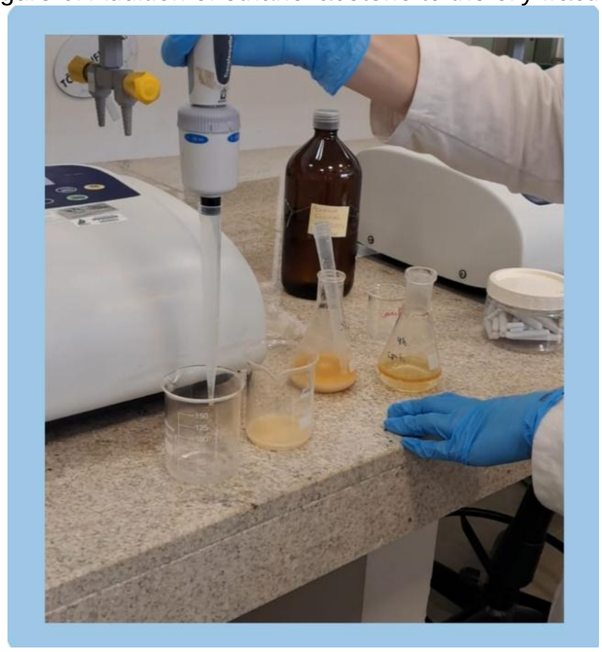
pH Calibration

- Make sure the pH meter is calibrated correctly before use;
- Wash the electrode with distilled water and dry with absorbent paper.

Titling

- With the pH meter immersed in the sample, slowly add a sodium hydroxide (NaOH) solution under constant agitation.
- Continue adding until the pH stabilizes at 11.
- Write down the volume of NaOH consumed for each sample.

Figure 6: Addition of ethanol acetone to the oily fraction



Source: The authors

Figures 7 and 8: Titration procedure

Source: The authors

***Note*:** The initial procedure was performed at 0 h. The same protocol was repeated for both samples, but they were subjected to a thermostatized bath at 35°C for periods of 2 hours and 4 hours, respectively.

Figure 9: Samples during the incubation period in a thermostatized bath at 35°C.

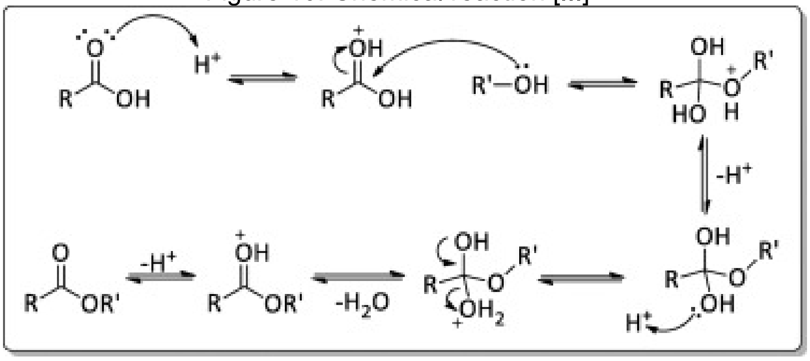
Source: The authors

BIOFUELS: A POSSIBILITY FOR SUSTAINABLE USE OF WASTE OIL

Biodiesel is the name given to alchemical esters of fatty acids as long as they comply with certain parameters of particularity. Because they are derived from biological sources such as plants and animals, they work as a substitute fuel for petroleum diesel, with very close performance, it does not require modifications in the engines. A large number of industries around the world, nowadays, employ industrial biodiesel production processes with the use of sodium monoxide as a catalyst, even though this technique requires the use of neutral oils, with low content of free fatty acids and low water content. Because it is commercially acquired in solutions of different concentrations, prepared to be used, free of water, which increases its efficiency and completely reduces the formation of soaps and undesirable results, unlike what occurs in the case of the preparation of alcohol, applied to caustic soda or caustic potash as catalysts (Abdoub, 2009).

One of the possibilities for reusing cooking oil is the production of biodiesel, being a counterpoint to fossil fuels that impact the planet's climate change. Chemically, biodiesels are compounds obtained through a transesterification reaction, when fatty acids, produced from different sources of lipids from, for example, the cooking oil used, react with an alcohol in the presence of a solid catalyst, generating ester and glycerin as a product according to the chemical reaction presented in the following figure.

Figure 10: Chemical reaction [...]



Source: Cavalcante (2015).

PROCEDURE FOR BIOFUEL PRODUCTION USING CHEMICAL TREATMENT

As mentioned earlier, the increasing demand for sustainable energy sources has been driving research and development in the field of biofuels. These are a viable alternative to fossil fuels, as they have a lower environmental impact and can be produced from renewable resources, such as plant biomass and agro-industrial waste. Among the production methods, chemical treatment plays a key role in converting feedstocks into high-yield, high-efficiency biofuels.

Chemical treatment in the production of biofuels involves specific reactions for the conversion of lipids, cellulose, or other organic compounds into liquid or gaseous fuels. In the case of biodiesel, for example, the transesterification of vegetable oils or animal fats with short-chain alcohols in the presence of a chemical catalyst is widely used (Demirbas, 2009). For the production of bioethanol, acid hydrolysis is a method used to break down complex polysaccharides into fermentable sugars (Balat et al., 2008).

The standardization of laboratory procedures for chemical treatment is essential to ensure the efficiency of the process and the quality of the final product. This script aims to describe in detail the procedures involved in the production of biofuels using chemical treatment of used cooking oil, covering everything from the choice of raw material to the purification of the biofuel obtained.

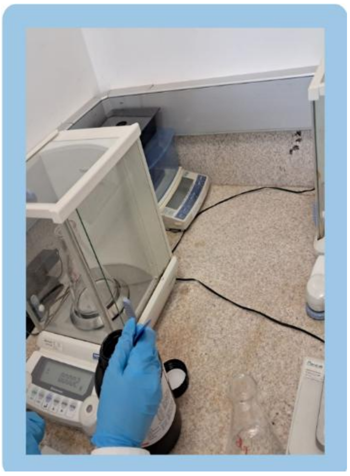
Sample 1 - Clearer oil

- Weigh 2 g of sodium hydroxide (NaOH) in a beaker;
- Add 30 mL of ethanol and stir the mixture for 2 minutes for complete dissolution;
- Add **100 mL of used frying oil** to the beaker containing the mixture and then take it to the **shaker**;
- **Shake for 15 minutes**;
- After this period, the sample is taken and added 25 **mL of alcohol, 5 mL of water and 1 g of sodium chloride (NaCl);**
- Then **stir the mixture by hand for 2 minutes** and let it stand **for 3 minutes**.

Sample 2 - Oil with a more turbid appearance

- The same procedure for sample 1 was repeated for sample 2, ensuring the standardization of the experimental conditions.

Figure 11: Weighing sodium **hydroxide (NaOH)** using a **closed analytical balance**, ensuring greater **accuracy and minimizing external interference.**



Source: The authors

Figures 12 and 13: Addition of ethanol

Source: The authors.

Figure 14: **Measurement of the oily fraction**, showing the process of quantification of the volume of oil present in the sample

Source: The authors

Figure 15: Oily fraction already separated and properly organized

Source: The authors

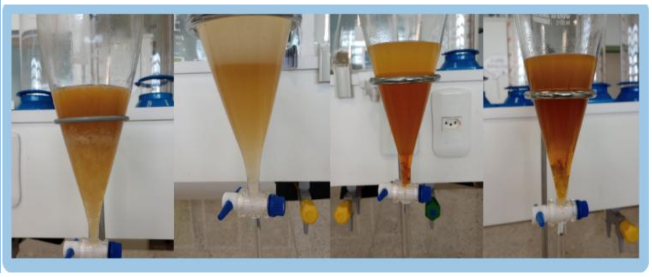
Figure 16: Oil in the shaker for agitation and homogenization of the sample.

Source: The authors.

Figure 17: Transfer of the oil to the settling hopper.

Source: The authors

Figures 18 and 19: Oil in the settling funnel.



Source: The authors

PROCEDURE FOR BIOFUEL PRODUCTION USING ENZYME TREATMENT.

In the process of producing biodiesel using animal or vegetable fat, NaOH can act as a catalyst for transesterification, a process in which triglycerides in the oil react with alcohol (usually methanol or ethanol) to form esters (biodiesel) and glycerol. The moderate temperature (35°C) favors the enzymatic activity, solubility and stability of free fatty acids. The thermal bath, on the other hand, provides stable, homogeneous and essential conditions for the formation, release and quantification of FFA.

Adequate amounts of FFA indicate that fermentation is active and in good condition, and free fatty acids are an important source of energy for microorganisms in biological treatments. However, excessively high amounts of FFA can acidify the medium, impairing the balance of the process, inhibiting methanogenic microorganisms, essential for biogas production and lead to the formation of soaps during transesterification, making it difficult to separate the biodiesel components.

Sample 1 - Clearer Appearance Oil

- Add 30ml of alcohol, 100ml of used cooking oil and 20.5ml of non-commercial enzyme, raise it to stir for 15 minutes in a shaker;
- Remove from the shaker, mix 25ml of ethyl alcohol and 50ml of water, shake for another 2 minutes and leave 3 minutes to rest;
- After resting, transfer the mixture to the decanting hopper.

Sample 2 - Oil with a more turbid appearance

- Repeat the same procedure as sample 1 in order to ensure standardization of the experimental conditions.

THE PRODUCTION OF SOAPS: PRACTICAL AND EASY METHOD FOR RECYCLING THE WASTE FRYING OIL.

The reuse of residual frying oil for soap production is a viable and sustainable solution for the improper disposal of this waste. This is a practical alternative, as it uses an abundant raw material that is often improperly disposed of. The manufacturing process involves a saponification chemical reaction, in which triglycerides in the oil react with an alkaline base, such as sodium hydroxide (NaOH), to form fatty acid salts (soap) and glycerol (Martins et al., 2020). In short, this is the reaction of an oil or fat with a strong base, resulting in the formation of soap and glycerol (glycerin) as byproducts. Triglycerides (oils or fats) are molecules formed by a glycerol bonded to three fatty acid molecules and strong bases, breaks down triglycerides into fatty acids and glycerol. Soaps are salts of fatty acids formed in the reaction, such as sodium stearate. Glycerol, on the other hand, is a useful by-product in the manufacture of cosmetics and other products.

Soap is a substance obtained by the reaction of fat or oil with sodium hydroxide, resulting in a salt. Soaps consist of organic salts, which are produced by a polar carboxylic ending (hydrophilic part) and another nonpolar hydrocarbon end (lipophilic part). In this sense, its molecules allow soap to dissolve equally into polar and nonpolar substances. This structure is responsible for cleaning processes and for diffusing small globules of oil in water (Caobianco, 2015).

Alcohol is a solvent used to mix and dissolve ingredients. However, alcohol is not necessary for the saponification reaction, which is the basic process of soap production, it is mainly used as an additive that improves some properties of soap such as antiseptic and aromatic, as it contributes to disinfect and give fragrance to the soap.

In addition to minimizing environmental impacts, this practice contributes to reducing costs in the manufacture of cleaning products and promotes the circular economy. Recycling waste oil can also generate social benefits, by enabling workshops and community projects that encourage environmental awareness and income generation (Ferreira et al., 2019).

However, to ensure the quality of the soap produced, it is essential to filter the oil to remove impurities before saponification and to perform tests to check the pH of the final product. Proper control of these parameters ensures that soap is safe for domestic use and environmentally beneficial (Lima and Carvalho, 2018). Below, we present two possibilities and practical scripts for soap production.

PROCEDURE FOR THE PRODUCTION OF BAR SOAP USING ALCOHOL.

- Dissolve **1 kg of sodium hydroxide (NaOH)** in **2.5 liters of water,** obtaining an alkaline solution;
- Add 6 liters of residual fat **to the dissolution,** promoting homogenization for **approximately 2 minutes;**
- Subsequently, incorporate **4 liters of alcohol**, and submit and mix to **stir for another 15 minutes;**
- After the process, **transfer** the solution **to a suitable reservoir** for storage.

Figure 20: Alcohol soap production process, with the steps involved in the saponification reaction and in the formation of the final product.

Source: The authors.

Procedure for the Production of Bar Soap Using Lemon Juice

- Dissolve **1.5 kg of sodium hydroxide (NaOH)** in **3 liters of lemon juice,** obtaining an alkaline solution;
- Then add **9 liters of residual fat** promoting homogenization for **approximately 15 minutes;**
- After stirring, transfer the **mixture to a suitable reservoir** for further processing.

***Note*:** To prepare **lemon juice**, the fruits must be **cut in half** and the juice extracted using a **manual or electric juicer**. Then, the liquid obtained must be **sieved** to remove seeds and pulp residues.

Figure 21: Lemon soap production process, highlighting the steps involved in the saponification reaction and in the formation of the final product.

Source: The authors

ENVIRONMENTAL ISSUE

After the Industrial Revolution, humanity has recorded and analyzed, through climate change and the insufficiency of non-renewable natural resources, the impacts resulting from development conducted in an unsustainable manner. Economic growth has stalled in the unsustainable use of natural resources and the degradation of the environment Environmental problems represent one of the main challenges faced by contemporary society in recent decades and important documents with guidelines based on sustainability have been formalized (Gonzaga, 2021).

Agenda 21, published in 1995, was built by the participants of the Rio/92 Conference, the Earth Summit, and promoted a global consensus and political commitment, based on the elaboration of action plans that meet sustainability at the global level. In 2015, the 2030 Agenda was accepted at the Sustainable Development Summit, comprising 169 goals and 231 global indicators, aimed at eradicating poverty, reducing inequalities, tackling climate change and promoting economic growth, all in harmony with the dimensions of sustainable development, which are: economic, social and environmental (UN, 2015).

To mitigate the environmental impacts caused by the irregular disposal of cooking oil, there are several technologies available to get around this, as we mentioned earlier: biodiesel production, enzyme treatment, and bar soap production. These technologies should be taught to students from high school (Gonzaga, 2021).

It is estimated that 1 liter of used oil can contaminate up to 1 million liters of water, which significantly compromises the quality of this essential resource for life (Silva *et al.*, 2020). Oil discharged into sewage systems, soils, or water bodies can cause severe impacts on ecosystems and the functioning of water treatment systems. In the aquatic environment, the oil forms a thin layer on the surface of the water, blocking the exchange of oxygen and harming living organisms, such as fish and aquatic plants. In addition, the oil can alter the chemical properties of water, making it difficult to be potable and to use it for agricultural or industrial purposes (Ferreira and Almeida, 2019). For all the above, it is necessary to find solutions for the improper disposal of waste oil, especially thinking about caring for the environment.

Biofuels have been widely studied due to their potential to replace the use of petroleum in the transportation sector. Conceptually, they are defined as compounds derived from renewable biomass, of plant and/or animal origin, which can be used in energy generation (CICONELLO, 2018), unlike petroleum products, they constitute one of the main sources of carbon dioxide (CO2) emissions of human origin into the atmosphere. Currently, the transport sector worldwide is almost entirely dependent on petroleum-based fuels, with one-fifth of global CO2 emissions created by these types of transport, which is responsible for about 60% of global oil consumption. Globally, it was estimated that in 2007 there were approximately 806 million automobiles and light commercial vehicles on the road, but these numbers are expected to increase to 1.3 billion by 2030 and to more than 2 billion vehicles by 2050. This growth could affect the balance of ecosystems and the global climate, as well as global oil reserves. There are ongoing research programs aimed at decreasing dependence on fossil fuels through the use of alternative and sustainable sources of energy, thus extending the period in which fossil fuels will be available (Balat, 2010). As alternatives to these environmental problems, we have the possibility of producing biofuels based on vegetable and animal oils.

CONCLUSION

The present work aimed to present the laboratory environment and the glassware used in this space as well as the important rules of use of these places, in addition to presenting the proposal of practical classes aimed at the use, treatment and valorization of residual frying oils, promoting an educational and sustainable approach to the management of these wastes. From the realization of the proposed activities, it was found that the theoretical contextualization combined with practical experimentation can contribute significantly to the awareness of the participants about the environmental impacts of the improper disposal of used vegetable oils. In addition, the proposals integrate the environmental theme with Chemistry laboratory activities and promote awareness about the importance of correct disposal, while stimulating the development of students' practical and cognitive skills.

The proposed experiments demonstrate the feasibility of reusing waste oil for the production of soap and biodiesel, evidencing its potential as a raw material for new products. In addition, the didactic activities tend to facilitate the understanding of the chemical concepts involved, providing students with a more dynamic experience applied to everyday life. The use of experiments, such as the production of biodiesel, soaps or enzymatic treatments, allows students to experience in a concrete way the chemical concepts discussed in the classroom. This brings scientific knowledge closer to the daily lives of students, showing the real application of science in the process of environmental preservation and in improving the quality of life.

The approach used in the experimental activities has the potential to stimulate critical and sustainable thinking, encouraging the adoption of more responsible practices in the disposal and reuse of oily waste. Thus, this chapter reinforces the importance of including experimental activities in the teaching of chemistry and the environment, favoring the construction of practical knowledge and the formation of citizens who are more aware and engaged in environmental preservation.

For future studies, it is suggested the expansion of experimental activities, contemplating other forms of valorization of residual oil, as well as the application of these classes at different levels of education to evaluate their impact on different audiences.

The science laboratory, as a space for experimentation and learning, emerges as an essential tool for the development of critical citizens who are aware of their role in preserving the environment. Thus, the importance of this material is reflected in the formation of a generation that is more prepared to face environmental challenges, based on sustainable solutions and the use of science for the common good.

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