UNIVERSIDAD DISTRITAL FRANCISCO JOSE DE CALDAS

VISIÓN ELECTRÓNICA

Algo más que un estado sólido

VISIÓN ELECTRÓNICA

Handmade coffee soap

Jabón artesanal de café

Laura Valentina Ramirez Ubaque[1], Paola Tatiana Fuelantala Mejia[2], Carlos Yesid Barrera Rojas[3], David Santiago Quintero Duran[4], Alexander Avarado Moreno[5]

Abstract

The production of handmade soaps involves the combination of natural elements such as herbs, oils and essences, offering significant benefits to the skin by providing vitamins and addressing various skin ailments.

This article focuses on developing artisanal coffee soaps for women in Valle del Cauca, especially in Sevilla, where 23.72% of the women reside in rural areas, generating about 60 kilograms of coffee sacks. The ingredients, including yarrow, aloe vera, Saponaria, glycerin, coffee, olive oil and water, were selected according to their beneficial properties and the client's needs, supported by a previous survey. The process culminated in the presentation of a product described in detail in a transparent black box, a balance was achieved between the inherent properties and the desired characteristics. The proportion of olive oil was increased to improve

[1]University student, Universidad Distrital Francisco José de Caldas, Colombia. Industrial Engineering E-mail: lvramirezu@udistrital.edu.co ORCID: https://orcid.org/0009-0000-2672-9973

[2] University student, Universidad Distrital Francisco José de Caldas, Colombia. Industrial Engineering E-mail: ptfuelantalam@udistrital.edu.co ORCID: https://orcid.org/0009-0008-5723-2458

[3] University student, Universidad Distrital Francisco José de Caldas, Colombia. Industrial Engineering E-mail: cybarrerar@udistrital.edu.co ORCID: https://orcid.org/0009-0007-2797-7988

[4] University student, Universidad Distrital Francisco José de Caldas, Colombia. Industrial Engineering E-mail: dsquinterod@udistrital.edu.co ORCID: https://orcid.org/0009-0005-6629-2995

[5] BSc in Mechanical engineering, Universidad Distrital Francisco José de Caldas. MSc in integrity Management and corrosion, Universidad UPTC, Colombia. Current Position: Universidad Distrital Francisco José de Caldas, Colombia. E-mail, aalvaradom@udistrital.edu.co - aalvaradomoreno@gmail.com . ORCID: https://orcid.org/0009-0006-7087-1014

hydration and the amount of Saponaria and aloe vera was increased, thus obtaining a creamier product that favors skin recovery and ensures a high-quality product.

Keywords: handmade, coffee, soap, women, natural, product.

Resumen

La producción de jabones artesanales implica la combinación de elementos naturales como hierbas, aceites y esencias, ofreciendo beneficios significativos para la piel al proporcionar vitaminas y el abordar diversas dolencias cutáneas.

Este artículo se centra en desarrollar jabones artesanales de café dirigidos a mujeres en el Valle del Cauca, especialmente en Sevilla, donde el 23,72 % de las mujeres residen en áreas rurales, generando unos 60 kilogramos de sacos de café. Los ingredientes, entre ellos milenrama, aloe vera, saponaria, glicerina, café, aceite de oliva y agua, fueron seleccionados según sus propiedades beneficiosas y las necesidades del cliente, respaldadas por una encuesta previa. El proceso culmina en la presentación de un producto detalladamente descrito en una caja transparente y negra, se logró un equilibrio entre las propiedades inherentes y las características deseadas. Se aumentó la proporción de aceite de oliva para mejorar la hidratación y se incrementó la cantidad de saponaria y aloe vera, obteniendo así un producto más cremoso que favorece la recuperación de la piel y asegura un producto de alta Calidad.

Palabras clave: Artesanal, Café, jabón, Mujeres, Natural, Producto.

1. Introduction

Currently, green products (recyclable bags, solar chargers or handmade soaps) are an increasingly important option in today's lifestyle; according to the analysis conducted by

Nielsen, the leading global authority on audience measurement, data and analysis, it is argued that, would be the trend of the next decade, 90% of young people are willing to pay for products designed and produced considering respect for the environment and sustainability [1]. Products such as handmade soaps, bamboo brushes or ecological notebooks, in sectors such as agriculture, fashion or construction, have sought to minimize the negative impact on the natural environment, using practices that respect the land and resources.

El Confidencial, a Spanish magazine, states that, "In the course of 2023, the Earth's capacity to regenerate its natural resources has been exceeded. Over the next 151 days until the end of the year, we will find ourselves in a deficit, depending on the accumulated reserves of natural capital" [2]. In the industrial field, attention has been directed towards the creation of products oriented to face daily ecological challenges. In places such as Valle del Cauca, the creation of enterprises that seek to improve the economy and establish production and consumption models that respect the ecological limits of the planet has been promoted.

In response to the global trend and contemporary ecological challenges, the handmade soap market has been an expanding niche in the personal care industry. Users are looking for natural and tailored alternatives for their daily skin care routines, and that is precisely what handmade soaps offer. Made with premium ingredients, these products stand out for their authenticity and uniqueness, offering many options, from traditional glycerin soaps to bars made with olive oil and goat's milk.

Coffee beans are the seeds housed in the edible fruits of the coffee tree. These seeds have significant qualities for the skin, since they act as detoxifying, firming and stimulating the circulation. Therefore, they constitute an excellent remedy against cellulite and other circulatory problems, such as varicose veins [3]. [4], the Uruguayan company TIERRAMIA, focused on

specialized articles for body and skin care, presents a natural handmade coffee soap, environmentally friendly and free of preservatives and parabens.

This study proposes the development of a business project focused on the production of handmade soaps made from coffee. The project would contribute to the cultural, economic and social wealth of the Valle del Cauca region, where women play a fundamental role. From the slopes of the mountains to the shores of the Pacific, the women of Valle del Cauca have forged a legacy of tenacity, leadership, and originality that deserves to be commemorated and discovered.

2. Theoretical framework

Coffee has several benefits for the skin when used in skin care products or topical treatments. Its ground particles act as a natural exfoliant, removing dead skin cells and unclogging pores, leaving the skin smoother. Caffeine stimulates blood circulation, which can reduce cellulite and improve skin firmness [5]. Coffee is rich in antioxidants, which protects the skin from free radicals and can counteract the early aging process [6]. It has attributes that help reduce inflammation and fight microorganisms, making it a beneficial resource for addressing problems such as swelling, redness, and acne. It is essential to use it sparingly and test on a small area of skin before spreading its use over the entire body, especially if you have sensitive skin.

Yarrow is a plant used in skin care products, such as in soaps, because, in its benefits, it contains antibacterial, antimicrobial, anti-inflammatory and antiseptic properties, which serve to soothe irritated skin, facilitate minor healing, keep the skin clean and control excessive oil production in the skin. [7]. Aloe vera has properties and benefits for the skin, such as reducing inflammation in damaged areas, burns or muscle discomfort. It has been shown that its daily use provides hydration and softness to the skin, acting as an effective cellular regenerator, which in turn delays the signs of aging and attenuates wrinkles, its high penetration capacity

and its ability to fight free radicals, works as an effective healing agent, helping to prevent and disguise the well-known stretch marks, fights irritations and dermatitis by stimulating and reinforcing collagen and elastin fibers. [8]. Olive oil is a highly beneficial ingredient in skin care products due to its ability to provide deep hydration, thanks to its healthy fats and antioxidants. In addition, it offers protection against premature aging by fighting free radicals, soothes skin irritation due to its anti-inflammatory properties, and can be used effectively as a cleanser and makeup remover. Olive oil is appreciated for its ability to promote smooth, healthy and nourished skin [9]. The combination of olive oil and saponaria will make the soap solid in consistency and will not allow it to become liquid.

Neutral vegetable glycerin plays a key role in soap formulation, acting as a natural humectant by attracting and retaining moisture, preventing the skin from drying out. Its emollient capacity softens and soothes the skin, which is beneficial for people with dry or sensitive skin. It is known for its ability to maintain transparency in soaps, making it ideal for the manufacture of transparent soaps to maintain their clear and translucent appearance [10]. The Saponaria plant, known as the soap plant or soapwort, contains triterpenoid or steroid glycosides, such as saponins, which are soluble in lipids and water. It provides benefits such as effective cleansing through antiviral, anticancer, antithrombotic, diuretic and anti-inflammatory action by removing dirt and oil efficiently [11]. Saponaria variants are hygienic plants, almost medicinal, suitable for making shampoos, soaps, toothpastes and bath gels, have a high foaming capacity in aqueous solutions and can replace caustic soda, harmful to the skin and the environment.

2.1. Methodology

2.1.1. Area of study

The production targets rural women in the department of Valle del Cauca, located in southwestern Colombia. This territory covers an area of 22,140 km² and is made up of 42

municipalities, according to data provided by DANE. It is bordered to the north by the departments of Chocó and Risaralda, to the east by Tolima and Quindío, to the south by Cauca, and to the west by the Pacific Ocean.

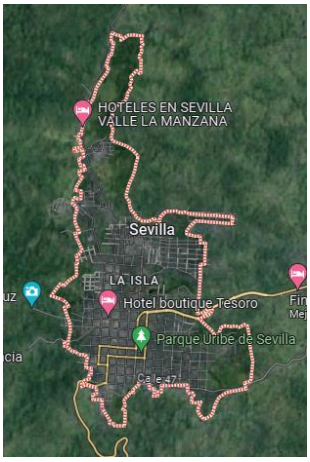
Figure 1. Location of the department of Valle del Cauca on map.

[23]

The location and environmental conditions of the department give it a high potential in the agro-industrial sector. As a result, it generates a production of around 1,200,000 bags of coffee of 60 kilograms each, which is equivalent to 11% of the total production of coffee in the country. In addition, the region covers 22% of the area of influence of the PCC (Coffee Cultural Landscape), with 30,000 hectares in the main region and 47,000 hectares in the buffer region, according to information provided by the ADR (Rural Development Agency) [12].

The production line focuses on Sevilla, where in addition to being representative in the coffee harvest, it has 23.72 % of women in rurality, of which 19.48 % have no educational level and 14.82 % are unemployed (DANE) (Figure 2).

Figure 2. Location of the municipality of Seville on a map.



[24]

2.1.2. Process

The making of handmade coffee soap involves a chemical reaction called saponification, which combines oils or fats with an alkaline solution to create soap, with the addition of ground coffee or coffee extract to give it an aroma and exfoliating properties.

2.1.3. Stage 1: Understanding coffee

The coffee cultivated in the small plots of Valle del Cauca comes from peasant, indigenous and afro-descendant communities, which take care of more than 51,000 hectares of Arabica coffee [13].

Arabica coffee is currently highly valued due to its qualities. Its harvesting process follows traditional methods, as shown in Figure 3.

Figure 3. The harvesting and selection of coffee.

[25]

Artisanal soap production requires a precise knowledge of the coffee beans. For this reason, a physical analysis of coffee is carried out to perceive its aromas and determine its level of humidity. An unpleasant aroma in the bean suggests low quality, while a percentage of humidity above 12% indicates excessive dryness that hinders the roasting process. High quality is considered when the moisture level is between 10.5% and 12% [14].

The degree of roasting directly influences the chemical composition of coffee beans, increasing phenols and caffeine, but reducing their antioxidant activity. To elaborate handmade soap, it is essential to know the appropriate type of mesh to grind the coffee beans, as detailed in Table 1.

Table 1. Mesh is used according to the type of coffee.

Premium	Mesh 18
Supreme	Mesh 17
Extra Special	Mesh 16
Europe	Mesh 15

[26]

Colombian mild coffee must contain at least 50% of beans that are retained above the 15 mesh. The beans of the 14 mesh are of the "Standard" category, while those that remain below the 13 mesh are called "Pasillas", encompassing beans with quality defects [15]. Figure 4 shows the result of the ground coffee.

Figure 4. Grinding process: (a) coffee seeds; (b) grinder; (c) coffee powder (photographed by the third author).

(a) (b) (c)

2.1.4. Raw material selection

Saponification, a key part in the manufacture of the final product under analysis, is based on the use of raw materials of natural origin. Its main objective is to separate fats in an alkaline environment, splitting them into glycerin and fatty acids. These fatty acids bind with alkalis to form the sodium salts of fatty acids, better known as soap [16].

The fundamental tables required to produce any variety of soap are called saponification tables (Table 2).

Table 2. Saponification table.

Saponification table	
0,134g Olive oil	0,190g Coconut oil
0,137g Cocoa butter	0,128g Shea butter

[27]

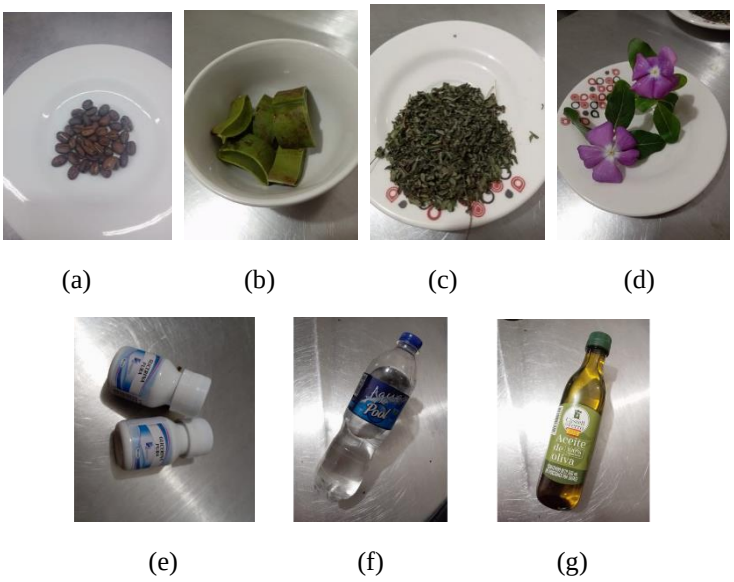
To calculate the precise amount of soda needed to saponify a particular fat, the corresponding value of that fat in a specific table is used and multiplied by the amount required. For example, to achieve complete saponification of 100 grams of olive oil (from 0.134), the operation is performed by multiplying 100 by 0.134, resulting in 13.4 grams of soda required [16].

Water plays a crucial role in the soap-making process by acting as the medium that facilitates the interaction between fatty components and alkalis during soap formation. Its primary function is to dissolve the alkaline elements and provide the environment in which saponification takes place. Normally, at the completion of the curing process, a soap retains 15% to 20% of its weight in water. At the processing stage, the proportion of water present can vary between 35% and 45% in solid soaps [17].

Saponaria is a plant recognized for its high concentration of saponins, compounds known for their emulsifying, foam-forming, hemolysis-inducing, antimicrobial and insecticidal properties. More than 40 different biological properties associated with saponins have been identified [18].

Figure 5 shows the image of the basic elements used to make soap.

Figure 5. Materials for the manufacture of coffee soap. Top row: (a) coffee seeds; (b) natural aloe vera; (c) yarrow; (d) Saponaria: (e) glycerin; (f) water; (g) olive oil. (Photographed by the third author).



2.1.5. Manufacturing process

The soap manufacturing process is detailed below:

1. Organization and arrangement of materials, supplies and tools needed to make soap.

2. The glycerin is poured into a container and heated until it reaches boiling point.
3. At the same time, water is heated to boiling point and the coffee is ground.
4. When the water temperature reaches 100 °C, the yarrow, ground coffee and Saponaria are added (Figure 6).

Figure 6. Addition of materials

Source: Photographed by the third author.

5. It is then left to stand for a period of 60 to 90 minutes.
6. After this time, the residues are divided.
7. Ground coffee, olive oil and aloe vera gel are added to the liquid obtained.
8. Then, glycerin is added to the mixture at a tempura of 60 °C.
9. The mixture is placed in the mold and allowed to cool for approximately 60 minutes (Figure 7).

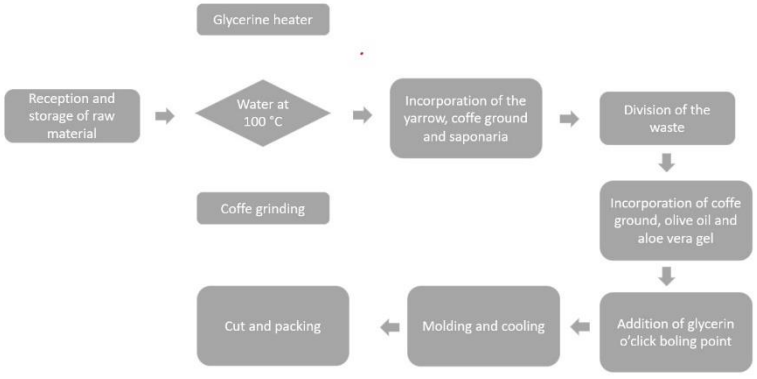
Figure 7. Product in the mold

Source: Photographed by the third author

10. Finally, they are unmolded and cut into bars, which are then packed in individual presentations.

Figure 8 shows the structure of the coffee soap manufacturing process.

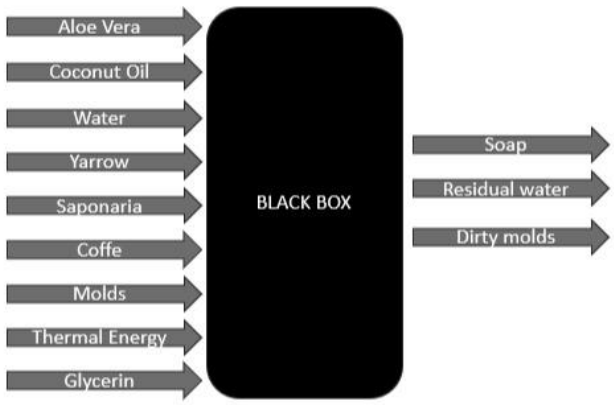
Figure 8. Manufacturing process for handmade coffee soap.



Source: Own elaboration

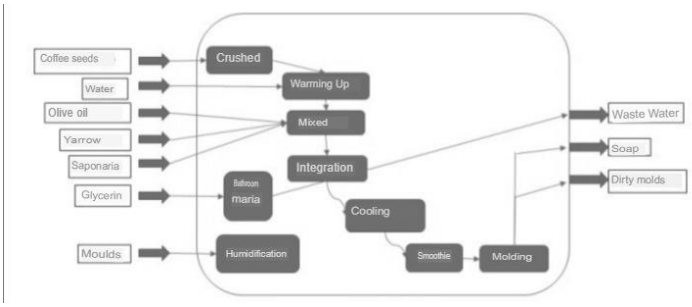
2.1.6. Stage 5: Functional decomposition

Figure 9. Black box



Source: Own elaboration

Figure 10. Transparent box



Source: Own elaboration

3. Results

Table 3 shows the proportions of each raw material used in the three combinations. The observations revealed that, by varying the amounts of each, the final product acquires distinct characteristics.

In the first combination, using a reduced amount of coffee seed, the absence of exfoliating properties was observed, and the scarcity of yarrow and Aloe vera caused a deficit in the antibacterial, soothing and regenerating properties of the skin. The amount of olive oil used favors skin hydration.

In the second combination, the amount of olive oil, coffee seeds, yarrow and Aloe vera was increased. This resulted in a soap with greater exfoliating capacity, more moisturizing and with more evident antibacterial, soothing and skin repairing properties.

In the third combination, a balance was sought between the inherent properties of each ingredient and the specifications sought in the finished product. The proportion of olive oil was increased to improve hydration, and the amount of other ingredients such as Saponaria and Aloe vera was increased to obtain a creamier product that contributes to the recovery of the skin, giving it an improved appearance.

Table 3. Mixtures made with raw material proportions.

Ingredients	Mix		
	1	2	3
Coffee Seeds (gr)	50	60	55
Saponaria (gr)	70	60	80
Glycerin (ml)	20	15	30
Yarrow (gr)	50	60	60
Aloe vera (gr)	70	80	90
Olive oil (ml)	100	150	130
Water (ml)	100	90	90

Source: own elaboration

4. Conclusions and recommendations

The use of soap is fundamental to personal hygiene care, with 98% of the world's population using soap for body cleansing. The wide range of forms, fragrances and benefits available on the market often leads to the choice of cheaper, mass-produced commercial options such as industrial soaps. These often extract glycerin, recognized for its skin benefits, and may include external agents with adverse health impacts.

Handmade soaps, on the other hand, contain beneficial components for sensitive and dry skin, which contribute to the treatment of skin diseases, among other benefits. The inclusion of ground coffee beans in soap represents a creative option to take advantage of coffee's skin-protecting benefits. The gentle exfoliation it provides improves skin texture and prepares the skin for absorption of other skin care products.

The proposal presented in this project is suitable to be implemented as a venture in Valle del Cauca, since it has the main raw material to manufacture the product. Adopting this initiative could give them a higher status in terms of social and environmental responsibility. Not only would it create new sources of employment and stimulate the circular economy, but it would also reduce the impact of coffee waste.

Recommendation: It is essential to monitor the temperature of the water when it reaches its boiling point, as it varies depending on the local atmospheric pressure. The lower the atmospheric pressure, the lower the boiling point of the liquid. This is because the particles experience a lower pressure and consequently have a lower kinetic energy, resulting in a decrease in temperature [19].

Acknowledgments

We want to extend my heartfelt gratitude to everyone who contributed to the completion of this project. To our professors and mentors, thank you for your invaluable guidance and for inspiring me to overcome every obstacle. To our classmates, your unwavering support and the moments we shared have greatly enriched this journey. To our family, your love, patience, and constant encouragement were essential in making this achievement possible. Lastly, we are grateful to all those who, in various ways, offered their knowledge, time, and dedication. Thank you all for being an integral part of this significant chapter in our life.

References

[1] “Young people prefer to buy products from brands that work for the planet.” La República newspaper. Accessed June 8, 2024. [Online]. Available: https://www.larepublica.co/responsabilidad-social/los-jovenes-prefieren-comprar-los-productos-de-las-marcas-que-trabajan-por-el-planeta-2955250

[2] Europa Press. "The planet today exhausts its natural resources for the whole of 2023 and goes into the red". El confidencial. [Online]. Available: https://www.elconfidencial.com/medioambiente/2023-08-02/planeta-agota-hoy-recursos-naturales-todo-2023-entra-numeros-rojos_3712414/

[3] "Coffee soap - Natural handmade soaps | OhJabon". Natural handmade soaps | OhJabon. Accessed November 8, 2023. [Online]. Available: https://ohjabon.com/comprar/jabon-de-cafe/

[4] "Handmade Coffee Soap (Exfoliating)". Tierra Mia. Accessed November 8, 2023. [Online]. Available: https://tierramia.mitiendanube.com/productos/jabon-artesanal-de-cafe-exfoliante/

[5] "Coffee Soap". Dulcementa. Accessed October 11, 2023. [Online]. Available: https://www.dulcementa.com.co/jabon-de-cafe#:~:text=Al%20aplicarlo%20como%20masaje%20activa,como%20estimulante,%20anticelulítico%20y%20exfoliantee

[6] "Coffee properties for the skin: discover all the benefits - laMalvaflor". La Malvaflor. Accessed October 11, 2023. [Online]. Available: https://lamalvaflor.es/propiedades-del-cafe-para-la-piel-descubre-todos-los-beneficios/

[7] "Yarrow flower. Default Store View. Accessed October 11, 2023. [Online]. Available: https://www.micosmeticacasera.es/milenrama-flor/

[8] infosalus. "Properties and benefits of aloe vera in skin care." infosalus.com. Accessed October 7, 2023. [Online]. Available: https://www.infosalus.com/estetica/noticia-propiedades-beneficios-aloe-vera-cuidado-piel-20190219122607.htmll

[9] "Properties and benefits of olive oil for the skin - Acofarma". Acofarma. Accessed October 7, 2023. [Online]. Available: https://www.acofarma.com/blog/aceite-de-oliva-para-la-piel/

[10] Pharmacius. "Glycerin soap: what is it good for and what are its benefits." pharmacius." pharmacius. Accessed October 11, 2023. [Online]. Available: https://www.pharmacius.com/blog/cosmetica-belleza/jabon-de-glicerina-para-que-sirve-y-cuales-son-sus-beneficios/

[11] "SOAPY, THE PLANTS THAT CLEANSE US". Spores. Accessed October 11, 2023. [Online]. Available: https://espores.org/es/es-plantas/jabonosas-las-plantas-que-nos-limpian/

[12] Food and Agriculture Organization of the United Nations Rural Development Agency. "Plan integral de desarrollo agropecuario y rural con enfoque territorial". Valle del Cauca. Accessed October 9, 2023. [Online]. Available: https://www.adr.gov.co/wp-content/uploads/2021/07/Valle-del-Cauca-Tomo-1.pdf

[13] "Coffee from Valle del Cauca - National Federation of Coffee Growers - Valle del Cauca". National Federation of Coffee Growers - Valle del Cauca. Accessed on November 8, 2023. [Online]. Available: https://valle.federaciondecafeteros.org/cafe-de-cauca/#:~:text=El%20café%20del%20Valle%20del,51.000%20hectáreas%20de%20café%20arábico.

[14] "Quality coffee: characteristics of Bonka. Coffee from sustainable cultivation | Bonka. Accessed November 9, 2023. [Online]. Available: https://www.bonka.es/amor-por-el-cafe/caracteristicas-cafe-calidad#:~:text=Un%20café%20en%20grano%20de,10,5%20y%2012%

[15] "How is the quality of coffee determined" What Coffee! Accessed November 9, 2023. [Online]. Available: https://quecafe.info/como-se-determina-la-calidad-del-cafe/

[16] "HOME | Begoña Rivero González | EducaMadrid". EducaMadrid. Accessed November 16, 2023. [Online]. Available: https://www.educa2.madrid.org/web/begona.riverogonzalez/inicio2/-/visor/reaccion-de-saponificacion-obtencion-de-jabon

[17] G. Távara, E. Córdova, V. Navarro, F. Pardo, and E. Soto, "Diseño de un sistema productivo artesanal de jabón aromatizado con esencia de naranja a base de aceite de cocina usado en el restaurante salomé ii del centro poblado jibito, sullana", Edu.pe. Accessed November 9, 2023. [Online]. Available at:

https://pirhua.udep.edu.pe/bitstream/handle/11042/3833/PYT_Informe_Final_Proyecto_JABONNARANJA.pdf?sequence=1&isAllowed=y

[18] "STUDY OF SAPONARIA OFFICINALIS FOR THE PRODUCTION OF A BIODEGRADABLE DETERGENT". Acervo Digital Educativo. Accessed October 14, 2023. [Online]. Available: https://ade.edugem.gob.mx/bitstream/handle/acervodigitaledu/63029/ISANGCHPTI515_Jabón%20revisado%20y%20corregido.pdf?sequence=3

[19] "Did you know that water does not always boil at 100ºC?". RETEMA. Accessed November 16, 2023. [Online]. Available: https://www.retema.es/actualidad/sabias-que-el-agua-no-siempre-hierve-100oc#:~:text=Cuanto%20menor%20sea%20la%20presión,la%20temperatura%20de%20ebullición%20disminuye

[20] C. Borràs. "How to make homemade soap without caustic soda - ecological recipes." ecologiaverde.com. Accessed October 14, 2023. [Online]. Available: https://www.ecologiaverde.com/como-hacer-jabon-casero-sin-sosa-caustica-1049.html

[21] Homemade Natural Cosmetics Shop. "How to make glycerin soap - Blog". Blog. Accessed October 13, 2023. [Online]. Available: https://www.cremas-caseras.es/blog/como-hacer-jabon-de-glicerina/#:~:text=Para%20fundir%20deberás%20alcanzar%20los,empiece%20a%20fundirse%20el%20jabón

[22] "How is the quality of coffee determined" What Coffee! Accessed October 15, 2023. [Online]. Available: https://quecafe.info/como-se-determina-la-calidad-del-cafe/

[23] No title. (s/f). Goo.Gl. Retrieved June 8, 2024, from https://maps.app.goo.gl/hN8Z57tutVGYniNu7

[24] No title. (s/f-b). Goo.Gl. Retrieved June 8, 2024, from https://maps.app.goo.gl/f8qjNBvqpFwufgNh6

[25] The harvesting and selection of coffee. (s/f). forumcafe. Retrieved June 8, 2024, from https://forocafe.es/foro/viewtopic.php?t=2188

[26] Posada, S. G. (2019, March 4). How is coffee quality measured? What Coffee; What a coffee. https://quecafe.info/como-se-determina-la-calidad-del-cafe/

[27] Saponification – Chemical reaction of soap. (2014, June 2). IPR Culture. https://culturaipr.wordpress.com/2014/06/02/saponificacion-reaccion-quimica-del-jabon/