Mol2Net, **2016**, 2, Section M, *doi:* 10.3390/MOL2NET-02-M???
http://sciforum.net/conference/mol2net-02

UNIVERSIDAD ESTATAL AMAZÓNICA
Educación académica de primer nivel, para formar profesionales y líderes de la más alta calidad
MODEC International Workshop on Modelization and Multidisciplinary Sciences for Development of Natural Products and Agro-Industrial Processess in Ecuador Amazon region

MOL2NET

SciForum
Mol2Net

Design of an industrial process focused on the elaboration of cosmetics from Amazonian oils: a Biotrade opportunity.

Diana Romero[1], Fernanda Aillón[1] , Angel Freire [3] and Matteo Radice[1*]
[1] Universidad Estatal Amazónica (Km 2 ½ Via Napo (paso lateral), Puyo, Pastaza, Ecuador); E-Mail: agi20140071@uea.edu.ec; agi20140003@uea.edu.ec, agi20140022@uea.edu.ec; mradice@uea.edu.ec;
* Corresponding author. E-mail address: mradice@uea.edu.ec Tel: +593 032-888-118 / 032-889-118

Received: / Accepted: / Published:

Abstract:
In Ecuador, the biodiversity offers a wide variety of plant species that, due to their characteristics, represent an alternative to produce cosmetics with high added value, environmental friendly and respecting Biotrade concepts.
The objective of this research was to design an industrial process in order to producing a cosmetic emulsion using as ingredient Amazonian vegetal oils, analyzing the mass and energy balance for a 10Kg turbo-emulsifier equipment and determining the capacity according to future productive development needs.

Keywords: Biodiversity, emulsions, Biotrade, mass and energy balance, capacity based on demand

1. Introduction

Ecuador is a privileged country in terms of biological diversity. It is included within the 17 megadiverse countries, considering that its territory covers only 0.2% of the Earth's land surface (1). Its biological richness is reflected in a variety of organisms, 18% of bird species, including 50% of those in South America, and 7% of amphibians (2). Within its surface is 7% of the vascular plant species that exist in the world, 11% of ferns, 20% of orchids (3) In addition to having a great biological wealth, it is important to emphasize that Ecuador is also a multi-cultural and multiethnic country, within it we find 14 nationalities and 10 of these are located in the Amazon Region (4).

Local biodiversity offers a huge range of natural products suitable for Biotrade activities (5), for example oils and plant extracts useful for skin care products. Plant extracts, due to antioxidant activity, are able to prevent or reduce oxidative damage. The bioactive compounds are usually flavonoids, polyphenolic compounds and anthocyanidins, mainly (6). The design of technology for the manufacture of emulsions has been intensifying with the passage of time. Today we have what is known as vacuum turbo-emulsifiers; These equipment are suitable for all preparations which require temperature and vacuum parameters controlled for example in the manufacture of: creams, milks, gels, oils, ointments, make-up, detergents and emulsions, for the cosmetic, pharmaceutical, chemical or food industry. For this study, we was supported by the Production department of the Chankuap Foundation (7), which mission is to create Biotrade cosmetic and to support Shuar and Achuar communities developing Fair Trade projects. Finally, the objective of this research is to design an industrial process in order to producing a quality cosmetic emulsion based on the use of Amazonian vegetable oils and in compliance with the Biotrade concepts.

2. Results and Discussion.

2.1 Product and technology

An O/W cosmetic emulsion has been obtained as described in the Figure 1. Figure 1 shows the flowsheet of the emulsion production process. This diagram has fundamentally two parts, the lipid phase mixer and the aqueous phase mixer.

2.2 Emulsion flowsheet

Both mixers carried out different operations such as adding raw materials, heating, adding the rest of the raw materials and cooling. These operations are performed as shown in Figure 2.

2.3 Plant capacity estimation

The Chankuap foundation started its activities in 2005, initially had a production capacity of 448 kg/a. In 2007 it increased its capacity to 1120 kg/a due to the increase of the demand of the product. In 2016 demand increased to 4144 kg/a. With this information of the increase of the demand was projected what could be in 10 years the increase of the demand and the capacity of production from 2016.

Figure 3 shows the tendency to increase the demand for the product up to approximately 7504 kg in the year 2026. This value could be estimated using the expression: $y = 336x - 673232$.

The production capacity is 7504 kg/a (40 kg/d) and can ensure to the Chankuap Foundation the market demand needs for the established time period.

2.4 Mass and energy balance

According to the capacity (40 kg/d of emulsion) and following the order of the technological scheme (figure 2) the mass and energy balances were realized. The results are shown in Table 1. These are divided into indicators of raw material, water and energy consumption and dumping of solid, liquid and gaseous waste.

Water is the fundamental component of the formulation as can be seen in Table 1. It represents more than 70% of the consumption of raw materials. The energy consumed in the heating process is 0.124 kW.

2.5 Viable economic alternative

The income was calculated from the sales prices of the emulsion. For the determination of the Net Present Value (NPV) and the Internal Rate of Return (IIR), 10 useful years are taken from the Chankuap Foundation, increasing to USD 202795.46 and 12.9%, respectively, with Payback (PB) before of 2.0 years. Figure 4 shows the behavior of the NPV in the 10 years, as well as the IIR.

Table 1. Consumption and emissions indicators.

Indicators	**Items**	**Amount**	**Unit**
Raw material consumption	Cacao Butter	0,08	kg/kg product
	Ungurahua OIL	0,08	kg/kg product
	Emulsifying agent	0,08	kg/kg product
	Preservative	0,015	kg/kg product
	Thickener	0,007	kg/kg product
	Parfume/essential oil	0,002	kg/kg product
water consumption	Process	0,74	kg/kg product
	Cooling emultion process	0,11	kg/kg product
Energy consumption	Water phase heating	0,21	kJ/Kg product
	Oil phase heating	5,4	kJ/Kg product

Figure 1. Emulsion flowsheet

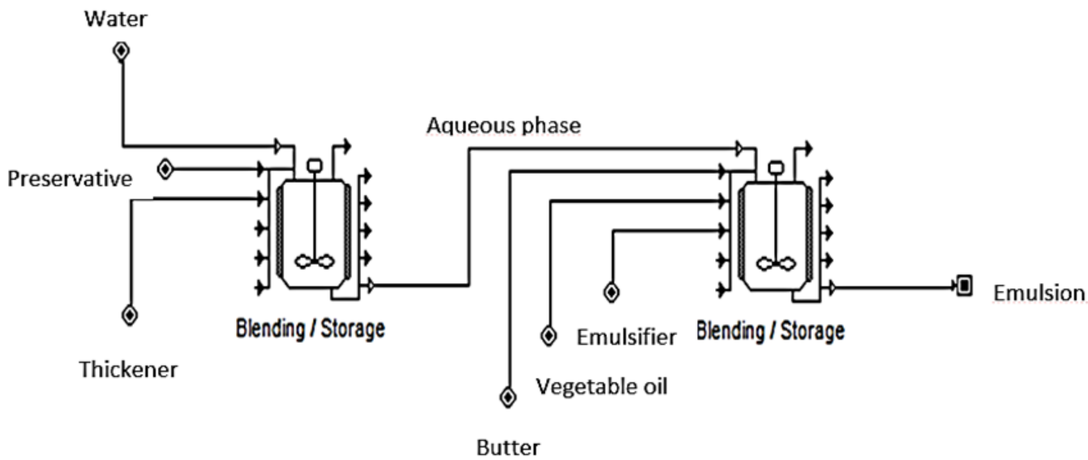


Figure 2. Technological procedure

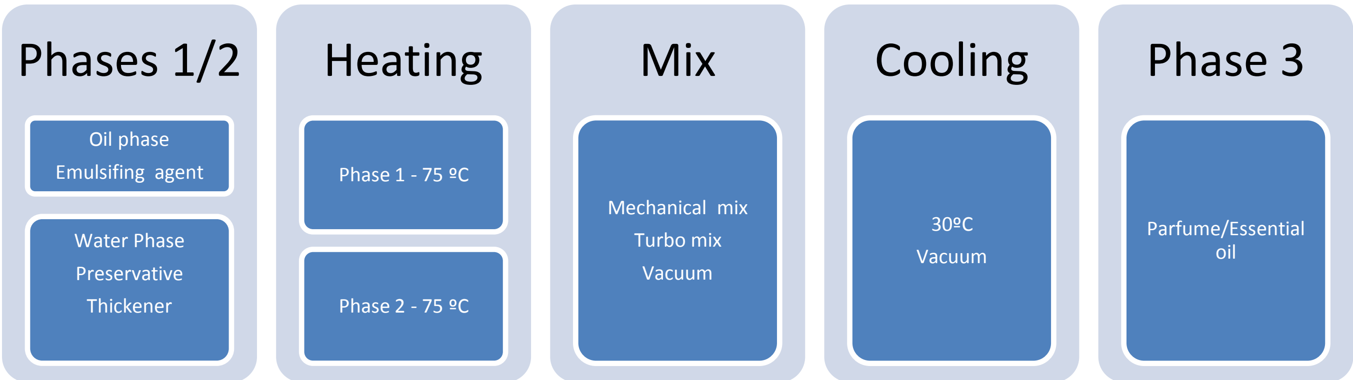


Figure 3. Plant capacity estimation

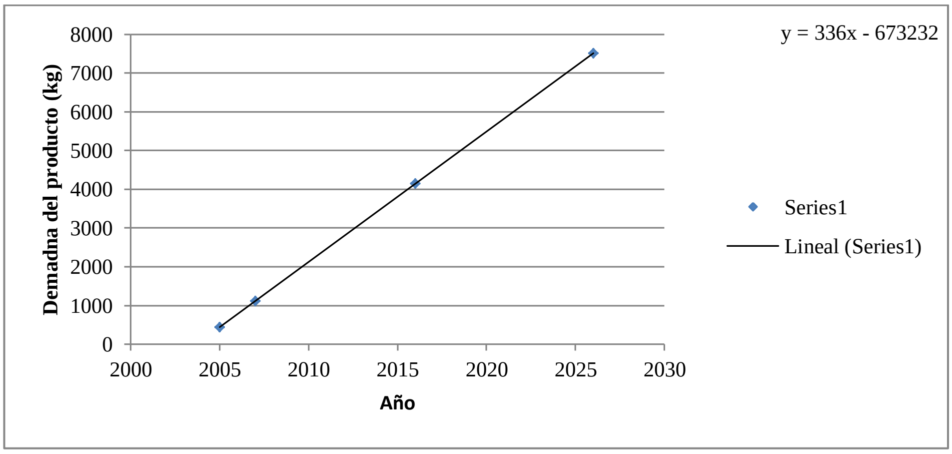
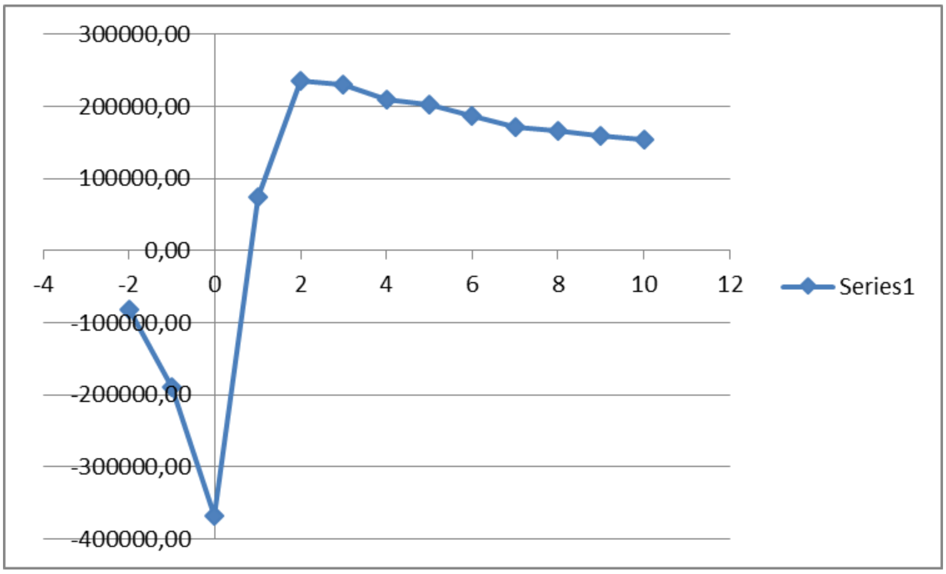


Figure 4. Economic indicators Fluctuation, NPV and PB



3. Materials and Methods

The procedure used in this research was proposed by Pérez-Martínez *et al*., (8). This procedure, although its utilization proposal is for the sugar cane industry and its derivatives can be used in other design scenarios. The method is based on the following steps: selection of technology, definition of the technological scheme, estimation of capacity and economic parameters, investment feasibility.

4. Conclusions

The local biodiversity offers a huge range of natural products suitable for Biotrade activities, Chankuap Foundation presents this kinds of alternative production as a business model for cosmetic market.

Finally, thanks to the dynamic investment indicators, VAN, TIR and PB, it has been possible to demonstrate favorable results regarding the analyzed cosmetic emulsion process.

Acknowledgments

The authors gratefully acknowledge the financial support of the Amazonian State University of the Republic of Ecuador.

Conflicts of Interest

State any potential conflicts of interest here or “The authors declare no conflict of interest”.

References and Notes

1. Mittermeier, R. A. (1997). Megadiversity: earth's biologically wealthiest nations. Megadiversidad: los países biológicamente más ricos del mundo: Agrupación Sierra Madre Cementos Mexicanos.
2. Ridgely, R. S., &Greenfield, P. J. (2001). The birds of Ecuador: status, distribution, and taxonomy (Vol. 1): Cornell University Press
3. Neill, D. A. (2012). ¿ Cuantas especies nativas de plantas vasculares hay en Ecuador? Revista Amazónica Ciencia y Tecnología, 1(1), 70-83.
4. Gutiérrez, R., López, E., Llambí, L., May, T., Ramírez, A., &Tocancipá-Falla, J. (2015). Higher Education and Indigenous Nationalities: Challenges for Inclusion in the Ecuadorian Amazonian Region. CreativeEducation, 6(9), 847.
5. Available online: http://unctad.org/en/Pages/DITC/Trade-and-Environment/BioTrade.aspx (accessed on 22-01-2017).
6. Mosquera, T., Noriega, P., Tapia, W., & Pérez, S. H. (2012). Evaluación de la eficacia cosmética de cremas elaboradas con aceites extraídos de especies vegetales Amazónicas: Mauritia Flexuosa (Morete), PlukenetiaVolubilis (Sacha Inchi) y OenocarpusBataua (Ungurahua).
7. Available online: http://chankuap.org/ (accessed on 22-01-2017).
8. Pérez-Martínez, A., Cervantes-Mendieta, E., Julián-Ricardo, M., González-Suárez, E., Gómez-Atanay, A., Oquendo-Ferrer, H., . . . Ramos-Sánchez, L. (2012). Procedimiento para enfrentar tareas de diseño de procesos de la industria azucarera y sus derivados. Revista mexicana de ingeniería química, 11(2), 333-349.