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Presentation of the Content

In the first chapter we present, *Web site layout for the sale of handicrafts from the municipality of Naupan, Puebla* by CÁZARES-HERNÁNDEZ, Isai, CASTILLO-QUIROZ, Gregorio, CRUZ-LUNA, Manuel and HERNÁNDEZ-CABRERA, Hugo, with adscription in the Instituto Tecnológico Superior de Huauchinango, as the following article we present, *Learning in the Biosphere Reserve in Entlebuch, Switzerland: Environmental Sustainability and Social Management* by JUÁREZ-SALOMO, Norma Angélica, SILVEYRA-ROSALES, Mariana Teresa, CUEVAS-OLASCOAGA, Miguel Ángel and ZAMORA-MIRANDA, Juan Martín, with adscription in the Universidad Autónoma del Estado de Morelos, as the following article we present, *Obtaining particulate agglomerates from the recycling of multilayer containers and PET/Al/PE* by ROSALES-DAVALOS, Jaime, ENRÍQUEZ-PÉREZ, Ma. Angeles, SOTO-MENDOZA, Gilberto and MASTACHE-MASTACHE, Jorge Edmundo, with adscription in the Tecnológico de Estudios Superiores de Jocotitlán, as the last article we present, *Validation of a pulp-type candy (Pulpijamay) based on the by-product of the hibiscus flower (Hibiscus sabdariffa)* by MAGAÑA-BARRERA Sara María De Jesús, LÓPEZ-SALAZAR, Blanca and BARAHONA-SÁNCHEZ, Gabriela, with adscription in the Tecnológico Nacional de México / Campus Villa La Venta.

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Web site layout for the sale of handicrafts from the municipality of Naupan, Puebla**Maquetado de sitio web para la venta de artesanías del municipio de Naupan, Puebla**

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Abstract

Currently the artisans of the municipality of Naupan, Puebla sell their handicrafts directly in their homes and little has been done for the use of information technology to increase sales, profits and reduce costs. This paper describes the research methodology that was followed with a qualitative process to present the layout of the website for the sale of handicrafts in the municipality of Naupan, Puebla. With this layout, a new form of commercialization or market niche is created that allows the reduction of the abandonment of the elaboration of products in the handicraft sector and contributes to preserve the culture and identity of the municipality.

Handicrafts, Methodology, E-Commerce

Resumen

Actualmente los artesanos del municipio de Naupan, Puebla realizan la venta de sus artesanías directamente en sus viviendas y poco se ha hecho por la utilización de las Tecnologías de la Información para aumentar sus ventas, ganancias y reducir costos. En este documento se describe la metodología de investigación que se siguió con un proceso cualitativo para presentar el maquetado del sitio web para la venta de artesanías del municipio de Naupan, Puebla. Con este maquetado se crea una nueva forma de comercialización o nicho de mercado que permite la disminución del abandono de la elaboración de productos en el sector artesanal y se contribuye en preservar la cultura e identidad del municipio.

Artesanías, Metodología, Comercio Electrónico

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Introduction

Rather than concentrating on the preservation of craft objects, safeguarding efforts should focus on encouraging artisans to continue making their products and passing on their knowledge and skills to others, particularly within their communities (Organización de las Naciones Unidas para la Educación la Ciencia y la Cultura, [UNESCO], 2022).

As a definition of handicraft products it is said that: they are those produced by artisans, either entirely by hand, or with the help of hand tools or even mechanical means, provided that the direct manual contribution of the artisan remains the most important component of the finished product. They are produced without limitation in terms of quantity and using raw materials from sustainable resources. The special nature of handicraft products is based on their distinctive characteristics, which may be utilitarian, aesthetic, artistic, creative, culturally linked, decorative, functional, traditional, symbolic, religiously and socially significant (Manila, Philippines, 1997). The artisan was also identified as an enterprising individual whose marketed handicrafts convey the values and teachings of his or her community (Rodrigues, A.O.A., Marques, C.S. and Ramadani, V., 2023).

With the ENCCUM (National Survey of Cultural Consumption in Mexico) conducted in 2012 by the National Institute of Statistics and Geography (INEGI) with the support of the then National Council for Culture and the Arts (now the Ministry of Culture) along with data from FONART and CONAPO, it was projected that by 2017 in Mexico the number of people who made some crafts aged 12 years and older would be 12,054,309, a figure that would correspond to 10.44% of the total population of the country (FONART, 2018).

According to INEGI, in the Culture Satellite Account of (CSCM), the culture sector generated 724,453 million current pesos in 2019, of which, crafts contributed 138,291 million pesos representing 19.1% of the cultural sector. And in that same year, handicrafts employed 489 890 paid occupied jobs; this represented 35.1% of the jobs employed by the culture sector as a whole (Instituto Nacional de Geografía e Historia [INEGI], 2021).

E-commerce is defined as: the process of buying, selling or exchanging goods, services and information through computer networks, for which payment may or may not be made online (Instituto Nacional de Geografía e Historia [INEGI], 2022).

The importance of this is that it is attractive for doing business because, in short, it can help increase profits; this is so because it increases sales and reduces business costs. Well managed advertising on the web can communicate the promotional message even of companies for potential customers in all countries (Schneider, Gary P, 2013).

Defining ICT, it can be stated that this term refers to the multiple technological tools dedicated to store, process and transmit information, making it manifest in its three known forms: text, images and audio (Zambrano, F., 2009).

In this era of constant technological advances the development of web applications is increasingly demanded, this is due to the increase of online activities including e-commerce of companies, so that nowadays professional developers are a very important factor in organizations (Basantes Suñiga, Á. J., 2022).

The design of websites presents important challenges such as the selection of an appropriate tool, the use of a development methodology to close the project with a delivery according to the requirements of the users and in the specific case of the Santo Domingo de Guzmán Foundation had to adapt to the needs of the idiosyncrasy that surrounds it. The use of a content manager brought with it the coupling to the characteristics of the WordPress tool that was selected and the subsequent training to end users to use it properly when managing future changes to the content of the site. Research techniques and methods were used to meet the prerequisite knowledge by taking into account both the internal staff of the institution and the patients of the medical center (Yacelga, A. R. L., Espinoza, J. L. A., & Cabrera, M. A. C., 2022).

A content management system is an application that allows the creation and administration of content, mainly in web pages (Rodríguez, M., 2021).

According to the analytics company W3Tech, approximately 43% of the websites in the world are managed by the WordPress CMS because it is the fastest and cheapest way to publish web content followed by Shopify, Wix, Squarespace, Joomla, Drupal, Adobe Systems, Google Systems, Bitrix and WebFlow, who are placed among the 10 most used CMS worldwide (W3Techs, 2022).

WordPress is a content management system based on the creation of blogs or weblogs, it is divided into two services, one is wordpress.com and the other is wordpress.org. Wordpress.com is a service focused on blog creation, which allows free or paid hosting offered by Automattic, developer of WordPress, allowing you to host your blog on their servers. Wordpress.org is an application that has to be installed on a host and linked to a database. This second service is more complete, so much so that it not only allows the creation of a blog, but Wordpress.org has evolved in such a way that it allows the creation of corporate pages, virtual stores, and much more (Rodríguez, M., 2021).

This article is intended to present the phases carried out to collect the contents for the construction of the layout of a website for the sale of handicrafts in the municipality of Naupan, Puebla.

It is presented in the methodology to develop an approach with data on population, location and marketing of crafts on the municipality of Naupan, Puebla and describes the activities by phases that were carried out to collect the information obtained from the different groups of artisans of the Municipality of Naupan, Puebla to make the layout of the website, in the results shows the distribution of the site with multimedia material generated, then it is found with the acknowledgements, conclusions and finally with the references used.

Methodology to be developed

Speaking of the population of the municipality of Naupan, Puebla this is composed of a total of 9,310 people, of which 4,320 are men and 4,990 women (Instituto Nacional de Geografía e Historia [INEGI], 2020). Its name comes from the Nahuatl voices: "nahui", four; "atl", water, and "pan", over; it means "Over four rivers or waters".

To this place, through which four rivers flow, Totonac groups arrived to settle and found the town that was formerly called Nexpan; "Over the ashes". In 1750 it was under the ecclesiastical jurisdiction of Huauchinango. In 1895 it was constituted as a free municipality. The parish church dedicated to San Marcos was built in the XVII century and is located in the head of the town. On April 25, the patron saint's day of San Marcos, which lasts eight days with wind bands, fireworks, masses, prayers, processions, popular dances, jaripeo and different dances such as "Los Negritos", "Los Santiangueros", "Los Tejoneros" and "Los Quetzales" (H. Ayuntamiento de Naupan, 2022).

It is bordered to the north by the municipalities of Pahuatlán and Tlacuilotepec; to the east by the municipalities of Tlacuilotepec and Huauchinango; to the south by the municipality of Huauchinango and the state of Hidalgo; to the west by the state of Hidalgo and the municipality of Pahuatlán (Instituto Nacional de Geografía e Historia. [INEGI], 2010, p. 1-3). It occupies a territorial space in which the differences in altitude are very marked, ranging from 560 meters above sea level to 2,240 meters, showing an ecological diversity that makes it possible for its inhabitants to have several simultaneous crops, in relatively close spaces but with notorious altitudinal diversity (Broda, J. & Good, C., 2004).

Naupan is located in one of the mountain ranges that cross the national territory from north to south, in the Sierra Madre Oriental. The region of which this municipality is a part is characterized by its ethnic and linguistic heterogeneity, which for centuries has been shared by Nahuatl (who are the majority in the state), Totonaca, Otomi and Tepewá groups in very close and sometimes almost imperceptible borders. This region was the seat of one of the most important cultures of pre-Hispanic Mexico, the Totonacapan, whose main center of power was El Tajín (Broda, J. & Good, C., 2004).

It is located in the northwestern part of the region called Sierra Norte de Puebla and whose majority of the population is indigenous Nahuatl or Mexican speakers (Broda, J. & Good, C., 2004), according to the bank of indicators of INEGI of the year 2020 the population of 5 years and more Nahuatl speaker (people) in Mexico was 1,622,170.

Of these 445,012 are from the state of Puebla and 7,042 live in the municipality of Naupan (INEGI, 2020), where the most important cultural practice of the region is the elaboration of textiles, made manually by most women over twelve years old. Likewise, it is one of the most important economic activities in the region, in addition to agriculture and commerce (Bernáldez, T., 2021).

The research methodology was followed with a qualitative process (Sampieri, R., 2018).

Figure 1 shows the phases for the research methodology employed:



Figure 1 Phases of the research methodology

Source: Own elaboration

The following is a description of the phases developed:

Phase 1. Idea

The objective was to design a website for the sale of handicrafts from the municipality of Naupan, Puebla with multimedia content.

Phase 2. Problem statement

In this municipality and as a product of their crafts are made embroidery, reed weaving, basketry and traditional costumes where the woman wears long black skirt, white blouse, shawl or shawl; the man wears underpants and shirt blanket, palm hat, huaraches strap and machete tape (INEGI, 2010, p. 1-3), plus handmade coffee, coffee liquor, panela as food sweetener and finally the development of clay pots. The marketing of handicraft products generated in the municipality of Naupan, Puebla is mostly done in the artisans' own homes since they lack commercial places or premises where they can sell their handicrafts.

They also go to regional markets, fairs and craft exhibitions, which means that they have to pay for their own transportation, food and lodging expenses, which results in an expense that significantly reduces their profits. As another way to market their handicrafts, the artisans have tried to use information technology tools such as social networks, in this case Facebook, but due to their lack of knowledge in the use of these, they have lost interest and have stopped updating their content, which included some photos of garments of their handicraft production.

Phase 3. Immersion in the field

Meetings, surveys and interviews were conducted with groups of artisans and all the multimedia material from the municipality of Naupan, Puebla was captured.

Phase 4. Conception of the design or main approach of the study

A directory of artisans was prepared, a product catalog was prepared, multimedia material was obtained for the promotion and identification of tourist and cultural sites, and the site was designed.

Phase 5. Definition of and access to the study sample

Work was done with the different artisans and groups of artisans who make crafts in the municipality of Naupan, Puebla.

Phase 6. Data collection

For the elaboration of the directory of artisans, meetings were held with the groups of artisans; Figure 2 shows the meetings with artisans.



Figure 2 Meetings with artisans

Source: Own Elaboration

A questionnaire was used to find out if they would like to promote and sell their handicrafts on a website.

Multimedia material was captured in order to define and elaborate the product catalog of the artisans and groups of artisans where their origins are described, the elaboration process is portrayed along with the techniques and tools used for the elaboration of their handicrafts through interviews, photos, video and drone shots. Figure 3 shows images of artisans' products.



Figure 3 Artisan products
Source: Own Elaboration

Multimedia content that promotes and identifies the culture was captured. Figure 4 shows a video of a tourist site.



Figure 4 Tourist site video
Source: Own Elaboration

Figure 5 shows a drone shot of a tourist site.



Figure 5 Drone shot of a tourist site
Source: Own Elaboration

Figure 6 shows an image of a cultural site in Naupan, Puebla.



Figure 6 Church of Naupan, Puebla
Source: Own Elaboration

Figure 7 shows 360° photos of tourist sites in the municipality of Naupan, Puebla.



Figure 7 360° shots of cultural sites
Source: Own Elaboration

Phase 7. Data analysis

A directory of artisans was created from the results of the questionnaire. Figure 8 shows the directory of artisans.



Figure 8 Directory of artisans of Naupan, Puebla
Source: Own Elaboration

With the multimedia material, the catalog of the different groups of artisans was created. Figure 9 shows the catalog of groups of artisans.



Figure 9 Catalog of artisans. Naupan, Puebla
Source: Own Elaboration

Results

With information obtained from the immersion in the field and the capture of multimedia material and interviews conducted, the layout of the website for the sale of handicrafts in the municipality of Naupan, Puebla is presented.

Phase 8. Interpretation of results

Figure 10 shows the home page of the website layout for the sale of handicrafts in which, through 360° images, video and drone images and text, information about the origin, culture and traditions and handicrafts as attractions to promote and publicize the municipality of Naupan, Puebla can be seen.



Figure 10 Website layout home page
Source: Own Elaboration

Figure 11 shows the artisans' catalog page of the website layout that allows to know the groups of artisans and the different crafts they manufacture.

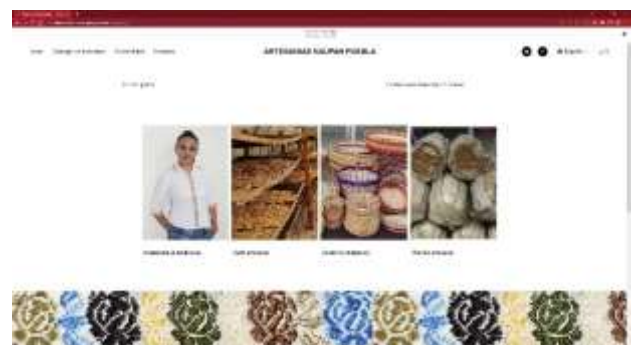


Figure 11 Artisans catalog page of the website layout
Source: Own Elaboration

Figure 12 shows the layout page of the apparel handicrafts catalog website.

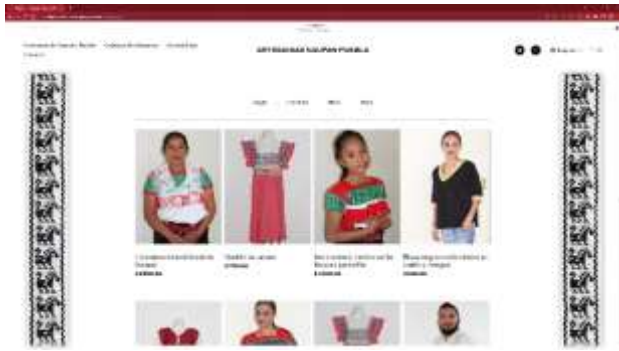


Figure 12 Catalog of handicrafts of clothing web site page
Source: Own Elaboration

Figure 13 shows the page of the description of the specific handicraft product of a group of artisans where the selection of the handicraft is made and added to the sales cart.



Figure 13 Page of the description of the specific handicraft product of a group of artisans
Source: Own Elaboration

Figure 14 shows the page that displays the description of the handicraft product or products selected by the customer for payment.

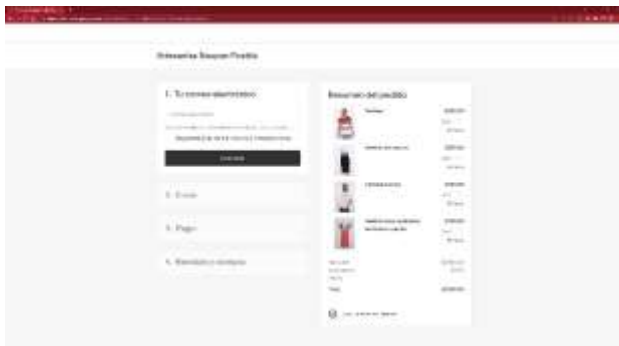


Figure 14 Page of products selected to make the payment
Source: Own Elaboration

Phase 9. Elaboration of the report of results

As results, we present the website layout that allows the promotion of handicrafts through e-commerce as a new form of marketing, to improve the economic growth of artisans and preserve the development of handicraft products, this layout was achieved with the participation of artisans in the region and the support of the H. Ayuntamiento de Naupan, Puebla 2021-2024.

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Conclusions

With the use of information and communication technologies, a multilanguage website (Spanish, English and Nahuatl) is configured and implemented in which the handicraft products of the native peoples of the municipality of Naupan, Puebla can be promoted and sold online to a local, national and international market with easy customer access to its product catalog.

With this multilingual website (Spanish, English and Nahuatl) the purchase operations are automated 24 hours a day, 365 days a year through e-commerce, allowing the customer to know the product catalog at a fair price and who and how it was made and encouraging them to purchase the product, creating new market niches for the artisans of the municipality of Naupan, Puebla, boosting the sale of their crafts locally, nationally and internationally, It also eliminates intermediaries and preserves their culture, traditions and customs, reduces inequality.

The digital divide and the abandonment of the elaboration of products in the artisan sector that would result in the loss of Mexico's cultural heritage since they are handmade with techniques in the process of extinction that if not followed up could disappear.

It also promotes the preservation, revitalization and transmission to future generations of their tangible and intangible cultural heritage, traditional knowledge and traditional cultural expressions, as well as all the elements that constitute the culture and identity of these peoples.

This project also promotes economic growth, employment, cultural work and local products of the native peoples of the municipality of Naupan, Puebla. In addition to promoting the recognition of indigenous communities and fostering equal opportunities, eliminating any discriminatory practices and promoting the development of indigenous communities in order to strengthen local economies.

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Learning in the Biosphere Reserve in Entlebuch, Switzerland: Environmental Sustainability and Social Management

Aprendizaje en la Reserva de la Biosfera de Entlebuch, Suiza: Sostenibilidad medioambiental y gestión social

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Abstract

The present study corresponds to the second stage of an investigation on the diagnosis and proposal for the application of destination criteria from an environmental approach in rural communities in the State of Morelos, with the objective of designing strategies for permanent intervention through training, on the use and management of solid waste for sustainable use and strategies for the reduction and recovery of recyclable waste, including environmental awareness campaigns. The Academic Body CAMOR 145-Management of Tourist and Cultural Heritage-CONACyT, responsible for the research, has defined two major initiatives, one of training through the visit to the Biosphere Reserve in Entlebuch, Switzerland and another of action, through the organization of a congress oriented towards the definition of social management needs, with a view to proposing activities for the application of the tourism sustainability criteria proposed by the Global Sustainable Tourism Council (GSTC) in order to provide guidance to communities on management strategies and safeguarding of the tourist heritage in their regions.

Environmental, Criteria, Biosphere, Sustainability, Diagnosis

Resumen

El presente estudio corresponde a la segunda etapa de una investigación sobre el diagnóstico y propuesta para la aplicación de criterios de destino desde un enfoque ambiental en comunidades rurales del Estado de Morelos, con el objetivo de diseñar estrategias de intervención permanente a través de la capacitación sobre el uso y manejo de residuos sólidos para su aprovechamiento sustentable y estrategias para la reducción y recuperación de residuos reciclables, incluyendo campañas de concientización ambiental. El Cuerpo Académico CAMOR 145-Gestión del Patrimonio Turístico y Cultural-CONACyT, responsable de la investigación, ha definido dos grandes iniciativas, una de capacitación a través de la visita a la Reserva de la Biosfera en Entlebuch, Suiza y otra de acción, mediante la organización de un congreso orientado a la definición de necesidades de gestión social, con el fin de proponer actividades para la aplicación de los criterios de sostenibilidad turística propuestos por el Consejo Global de Turismo Sostenible (GSTC) para orientar a las comunidades sobre estrategias de gestión y salvaguarda del patrimonio turístico en sus regiones.

Medio Ambiente, Criterios, Biosfera, Sostenibilidad, Diagnóstico

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Introduction.

In the year 2022, to deal with the harmful effects that the COVID-19 pandemic had on tourist activities in the rural communities of Morelos, the first stage of a research was carried out whose objective was to obtain elements for the promotion, development, and economic reactivation of the tourism sector (Juárez-Salomo, 2022). This first study was focused on the analysis and application of tourism cultural sustainability criteria, proposed by the Global Sustainable Tourism Council (GSTC) to provide guidance to three Morelos communities, Tepoztlán, Tlayacapan and Chalcatzingo, centered on management strategies and safeguarding of the tourist heritage in each entity, with emphasis on cultural aspects.

As one of the most relevant findings of the named study, the urgent need to address not only cultural issues was detected, but also the need to influence in a timely manner aspects of social management for the application of environmental criteria, considering a permanent intervention for training on the use and control of solid waste for sustainable practices and strategies for the reduction, recovery, and use of recyclable waste, including environmental awareness campaigns focused on the 3R (reduce, recycle and reuse). Thus, from the Academic Body CAMOR 145-Management of Tourist and Cultural Heritage-CONACyT, responsible for the investigation, action initiatives were defined.

To act proactively and with the intention of continuing with the research work, two strategic objectives were defined that aimed, the first, at deepening management initiatives for environmental protection and, the second, at opening of spaces for training and reflection for the definition and implementation of sustainability criteria regarding environmental aspects.

The first initiative began in March, when international collaboration links were established with the UNESCO Biosphère Entlebuch, an instance that contributed to the nomination of the aforementioned environment as a reserve (MAB-UNESCO, 2002, p.30) and inhabitants of the region, and a field visit to the biosphere reserve in a rural Swiss community was promoted, in order to have advice to, on the one hand, learn about the operation of environmental and waste management strategies and, on the other.

Conceive initiatives for research and monitoring, education, training and community participatory decision-making that can be replicated in related projects in rural environments, for that matter, in the State of Morelos.



Figure 1 Biosphère Entlebuch. Renggli, Franz, 2010

The second initiative corresponds to the organization of events such as the Social Congress of Rural Heritage 2023, permanent workshops, start-up, and pilot areas in two of the communities that were part of the first stage of the project (Tepoztlán and Tlayacapan) where themes and spaces were considered critical for raising awareness and dissemination of the challenges of rural communities regarding environmental criteria and socioeconomic sustainability.

It should be noted that, even when it is evident that the government and economic conditions are not like the European country of reference or to the cases that are presented at the congress from other Latin American countries, initiatives have been sought that have an impact on the construction of reference frameworks and inspiration for the design and implementation of dissemination and social management activities, promoting both specific learning about criteria and social initiatives, as well as the involvement of communities at various levels in management issues of protected areas in order to influence sustainability, moving from reflection to action.

Thus, in this article two main lines are addressed that look at the development of current and future actions in a comprehensive and systemic way: environmental sustainability and social management.

Economic growth, care for the environment and the well-being of society.

In the most recent decades, environmental sustainability has come to form a priority element in social management projects, especially considering the common planetary destiny. The 2030 Agenda for Sustainable Development and the Sustainable Development Goals (UN-ODS, 2017) for example, have determined specific actions and criteria to ensure planetary sustainability.

By conceiving sustainability to develop an environment that considers and satisfies the needs of the present without compromising the capacity of future generations, then the work of prospective planning is both urgent and challenging, since it requires a high degree of awareness and, above all participatory action, since it is not enough to know what can happen with the existing natural resources, the action of various organizations and actors is also required to counteract the devastating inertia of the ecosystems.

Regarding sustainability, Randy Durband, CEO and Luigi Cabrini, president of the GSTC, argue that a key part of insisting on sustainability is the need for solid long-term management, which helps companies and destinations to be more resistant. In this sense it is accepted that sustainability "...means continuing to function and prosper in perpetuity, through all kinds of conditions... this pandemic can serve as a moment in time when we all step back and reflect on our long-term goals and how to apply the principles and practices that enable us as organizations... to maintain happy, healthy and purposeful lives" (GSTC, 2016).

In the sense proposed by Durband and Cabrini, sustainability in combination with management commits the actors in the search for a balance between economic growth, care for the environment and social well-being.

Talking about social and community management implies reflecting on the generation of both diagnostic and preventive initiatives, which allow timely action on rural environments; It is important to underline that the understanding of the problems and the definition of alternatives require not only theoretical analysis, but also inspiring initiatives that allow us to see how strategies work in real scenarios.

The case of Entlebuch represents a clear example of how, after an ecological tragedy that occurred in the 80s, it has achieved a dizzying tourism development carried out through integrating strategies, with a conscious, innovative, and strategically planned development approach, in accordance with the environmental protection philosophy of the canton of Lucerne and the country.

Finally, it should be emphasized that the growth raised from the care of the environment and society, must arise based on responsible actions that consider the risks and impacts of the alternatives to be adopted, since it must not be forgotten that social action manifests commitments and a harmonious relationship with the communities that must be characterized by respect and empathy (Euroinnova, 2023).

Environmental Sustainability Criteria and their link with social management

When returning to the list of GSTC criteria (2022), it is important to point out that these have a double aspect: 1) On the one hand, they are oriented to the review of the initiatives of the tourism industries (hotels, restaurants and related services) and on the other b) considers tourist destinations (zone or geographical area visited by tourists), and for this it is based, in turn, on four fundamental pillars as stated in figure 2:

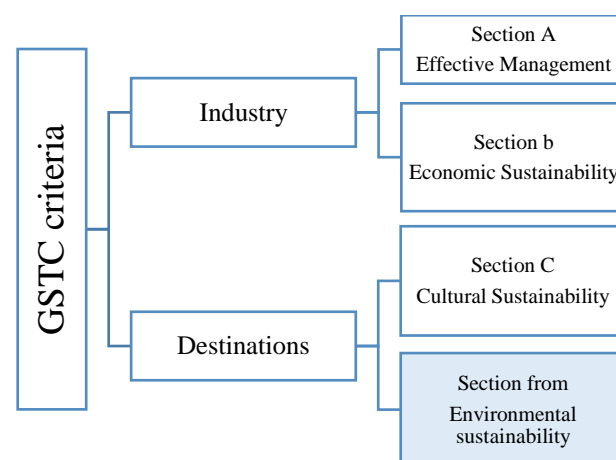


Figure 2 GSTC Tourism Environmental Sustainability Criteria

Own Elaboration, 2023

In a very summarized way, the mentioned criteria are defined as:

- a) **Efficient management:** Oriented towards sustainability, it seeks the use and continuous supply of resources, especially natural ones, to cover the needs of the present, without compromising the needs of future generations.
- b) **Socioeconomic sustainability:** These are financially profitable economic and social practices that are sustainable.
- c) **Cultural sustainability:** Respect for cultures and incorporation of the customs and traditions that characterize the contexts to be visited; and Environmental sustainability: Conservation of the environment through co-responsibility initiatives.

Considering the four pillars, according to the GSTC, it is possible to achieve sustainable tourism in the long term, safeguarding the resources that attract visitors (natural and cultural attractions, community experiences) since this type of tourism, when managed and markets effectively, it can also give companies a competitive advantage by proactively responding to current consumer trends.

Market research for one project shows a growing demand for experiential travel; more visitors are looking for an authentic connection to the local culture, food, customs, heritage, and people in the destinations. At the individual business or organization level, implementing sustainability practices is a key part of ensuring smooth and efficient operations (GSTC, 2022).

As previously mentioned, there are two service approaches, industry, and destinations, the second being the one that has been considered for this research, specifically from an environmental perspective that considers the elements illustrated in Table 1:

GSTC Destination Criteria
SECTION D: Environmental Sustainability
D(a) Conservation of natural heritage
D1 Protection of vulnerable environments
D2 Management of visitors to natural sites
D3 Interaction with wildlife
D4 Exploitation of species and animal welfare
D(b) Resource management
D5 Conservation of energy
D6 Water management
D7 Water quality
D(c) Waste and emissions management
D8 Wastewater
D9 Solid waste
D10 Greenhouse gas emissions and climate change mitigation
D11 Low-impact transportation
D12 Light and noise pollution

Table 1 GSTC Tourism Environmental Sustainability Criteria

Own Elaboration, 2023

Considering the previous criteria, it is clear to observe that each one depends on collaboration and social participation at different levels, in the idea that the application of the criteria is in well-conceived industries or tourist destinations, promotes both internal and external positive impacts.

A positive link between environmental sustainability and adequate social management internally leads to greater commitment of workers with the activities and implementation of the sustainable management system, by carrying out (evaluated) training on roles and responsibilities.

Awareness of the impact on the development of the destination contributes to achieving customer satisfaction, decreases employee turnover rates, promotes a favorable work environment, allows flexibility in schedules, as well as devising incentives for good performance of functions.

The benefits of the company's external relations and communications positively encourage greater participation in the organization, sustainable planning and management, local, national, and international credibility, use of logos, access to other certifications, greater projection, and possibilities of collaboration. branding and to show an example that, for that matter, is a biosphere reserve in Central Europe.

Biosphere Reserves, Entlebuch as a reference

The Biosphere Reserve concept, initially developed in 1974, was specified and reinforced in 1995, at the second world meeting of Biosphere Reserves. The results of this meeting were included in the Seville Strategy and the Statutory Framework of the World Network of Biosphere Reserves, documents that today continue to be the referential basis of the Network (UNESCO, 2017).

As one of the members of exemplary development, is the Entlebuch biosphere reserve, a nature environment at the foot of the Swiss Alps that includes the great valley of 395 km² where the Little Emme river crosses, between Bern and the Swiss canton. from Lucerne. It was in 2001 that the region, hitherto little known internationally, became, after the Swiss National Park, the second UNESCO biosphere reserve in Switzerland (figure 3). On May 25, 2002, the inauguration ceremony of the Entlebuch Biosphere Reserve (UNESCO, 2003) was held.



Figure 3 Alp Risch, Entlebuch. Renggli, Franz, 2012

From a tourist point of view, the Entlebuch biosphere not only offers calm and relaxing landscapes in untouched nature; At present, but many tourist activities have also been developed, including themed hiking, such as fairy tales or energy, Kneipp spa that provides the benefits of bathing in water and even mud, satellite-guided hiking, or excursions with a guide, among many other possibilities. In addition to the many leisure activities, the historical and cultural richness allows to enjoy the traditional crafts of the charcoal makers in Romoos or the pilgrimage center of Heiligekreuze (UNESCO, 2003).

In the so-called "Wild West" of Lucerne, the largest swamps in Switzerland abound and a fauna and flora of both national and international importance characterized by its pre-alpine marsh and limestone landscapes of almost 400 square kilometers that are home to the majestic peak of the Schrattenfluh.

In truth, the tourist experience in Entlebuch may seem idyllic but, although it is not believed, according to the diagnoses carried out by UNESCO, the Man, and the Biosphere Program (MAB) and testimonies of some inhabitants of the region, the development of the image and tourist activities have not been free of setbacks. There are approximately 17 thousand people living in the biosphere reserve and 36% of the population is linked to the primary sector.

According to the Reservation Bulletin, there is a shortage of attractive, modern jobs for highly educated people in Entlebuch, and many young people are forced to migrate to larger cities. Therefore, regional development has been one of the main concerns of the biosphere reserve in question. The Swiss government, the canton of Lucerne, and local and environmental groups have made financial contributions to the development of the region, at an estimated annual cost of SFr 1 million, thereby creating jobs (MAB-UNESCO, 2002).

In addition to the situations mentioned, political and cultural resistance led to the nomination as a reserve being achieved after a long process, since the democratic government system, combined with the initial skepticism of the local inhabitants, stopped the process. It was not until the vote in favor of the presentation was achieved, in the year 2000, by 94% of the inhabitants of the eight communes that the project advanced (MAB-UNESCO, 2002).

At present and thanks to the determined work of the villagers, the Entlebuch Biosphere Reserve represents an opportunity to promote sustainable tourism, a way of cultivating natural resources, and a market for quality regional products, and some young farmers have given the commercial potential offered by being part of the biosphere reserve (MAB-UNESCO, 2002).

Training in social management of natural resources

To carry out an informed approach to the present investigation, in the first instance, various sources related to the subject were reviewed and defined, first on how to evaluate sustainability through the GSTC criteria for the tourism field and, second, various publications generated within the Program on Man, and the Biosphere (MAB) were reviewed.

The MAB (started at the beginning of the 70s), is an Intergovernmental Program created with the objective of establishing a scientific base to improve the relationship of people with their environment, promotes interdisciplinary research in natural and social sciences and management training of natural resources on the conservation and sustainable use of biodiversity (MAB-UNESCO, 2002).

Through the resources provided by MAB, it has been possible to better understand the environment, including global change, and to encourage a greater commitment of science and scientists to the development of policies related to the rational use of biological and cultural diversity (MAB) (UNESCO, 2002).

Thus, through the experiences of countries around the world, the most appropriate practices are currently analyzed to proceed with the design of training, dissemination, and research groups to continue contributing to the management and care of the planet's natural heritage.

Considerations for tourism development in biosphere reserves

Regarding the protection of the environment, the World Tourism Organization (UNWTO) openly promotes the promotion of responsible, sustainable and accessible tourism with an emphasis on compliance with the 2030 Agenda for Sustainable Development and the Sustainable Development Goals (UN -ODS, 2017) whose scope is universal, offering leadership and support to the tourism sector in order to expand knowledge and promote tourism policies around the world, leading its steps towards a responsible tourism activity that serves as a driving force for economic growth, inclusive development and environmental sustainability.

Currently made up of 156 countries, the UNWTO encourages the application of the Global Code of Ethics for Tourism, to maximize the socioeconomic contribution of tourism and at the same time minimize the possible negative impacts that it could have (UNWTO-OAS, 2022). Therefore, from a positive point of view, responsible tourism has proven to be an ally of sustainability, as it is linked to social, cultural, and environmental development initiatives.

Tourism seen in a negative light (if not properly managed) can lead to loss of local identity and values, through the commodification of cultures and unwanted changes to meet tourism demands, develop a negative attitude of the host community, and even gradually destroy the environmental resources on which it depends (One Planet, 2021). As a measure to prevent the depletion of natural resources, pollution, and the degradation of the territory and its ecosystems, eyes are directed towards sustainable tourism, whose base is intentional respect for the various ecosystems, ensuring that the activities of the industry and tourist destinations produce the least possible impact on the environment and local cultures (Seateros, et.al. 2019).

Sustainable tourism seeks the generation of jobs and income, proposing strategies to act respectfully with the lives of the inhabitants, especially safeguarding native cultures. In line with the UNWTO and the Environment Program of the United Nations Organization, sustainable tourism broadly considers the economic, social, and environmental impacts, both in the present and in the future, taking into account the needs of visitors, the industry, ecosystems and host communities (WTO-UNEP, 2019).

Methodology

To carry out this research, a first stage of research carried out in 2022 was taken as a background, carried out with the purpose of obtaining elements for the promotion, development and economic reactivation of the tourism sector (Juárez-Salomo, 2022) through the application of tourism cultural sustainability criteria, proposed by the Global Council for Sustainable Tourism, providing guidance to three Morelos communities, Tepoztlán, and Tlayacapan, on management strategies and safeguarding of tourist heritage in each entity, with emphasis on cultural aspects.

In this second stage, the focus of attention is the environmental sustainability criteria of the GSTC but, in addition to the applicability analysis, two strategic objectives were established:

A) The deepening of management initiatives for environmental protection through field visits to a European biosphere reserve (in addition to the Latin American reserves already visited) and B) The opening of spaces for training and reflection for the definition and implementation of sustainability criteria regarding environmental aspects.

As part of the second initiative, permanent events and workshops are organized where, through various strategies such as focus groups, questionnaires, interviews, among other resources, elements are obtained to prepare specific proposals for the communities that were part of the study in the first stage of the project (Tepoztlán and Tlayacapan) where critical issues and spaces for raising awareness and dissemination of the challenges of rural communities regarding the criteria of environmental sustainability were considered.

Results

Regarding the initiative of a field visit to the Entlebuch Biosphere Reserve, what was reviewed in the documents was contrasted with the observations in the area because, although life in Switzerland resembles a bucolic postcard image where lakes, mountains, snowy landscapes and clean air characterize the environment, like many countries, this European nation has had to make enormous efforts to protect its environmental heritage for which, in recent years, the Federal Council and the people of Switzerland have implemented a series of concrete measures. From the observations and documents reviewed for this research stage, the following points are recovered (FDFA, 2020):

Protection of natural resources

Strategies for the reduction and recovery of recyclable waste are favored, including environmental awareness campaigns favoring the use of renewable energies in the exploitation and production of resources (see figure 4).

Concentrating urbanization

The Land Planning Law, accepted by the people of Switzerland in 2013, has two main objectives: to use available space more efficiently and to combat the excessive spread of built-up areas as strategic measures to preserve agricultural land.



Figure 4 Widen, Entlebuch. Renggli, Franz, 2013.

Waste management

The policy on waste and products is based on the principles of the green economy, promoting the recycling of primary products, and reducing both their demand and the production of waste.

Contribute to the fight against global warming

As measures to limit the increase in atmospheric temperature to less than 2°C, the focus has been on reducing greenhouse gas emissions. Coupled with the action plan adopted in 2014, the carbon tax has been increased substantially, especially for the construction and transportation sectors.

Preserving water quality

Known as the “water tower of Europe”, Switzerland is rich in many lakes and rivers, such as the Rhine and Rhone, and in the Little Emme Biosphere Reserve that are located on its territory.

Purification stations built since the 60s and 70s, guarantee a very high quality, having eliminated micro-contaminants caused by phytosanitary products from agriculture and adding a new step in the treatment of wastewater in more than one hundred water treatment plants. With the measures adopted, it is expected to improve river water by 2030, including the benefits that the new constructions underway and the renovation of existing water treatment plants will bring (FDFA, 2020).

Long-term maintenance of biodiversity

As a measure for the protection of biodiversity, specific protection laws were established, to safeguard the more than 50,000 living species, since currently, due to urbanization, more than 30 % of the species studied are threatened (FDFA, 2020).

Air Quality

The quality of the air in Switzerland has been improving permanently since in the last 25 years the emission of fine particles in the cities has been reduced by more than 50% due to the use of clean energies and its regulations towards the industry, where the The Confederation imposes strict regulations on CO2 emissions through the installation of high-performance filters and catalytic converters in vehicles (FDFA, 2020).

Land use for environmental balance

Even though urbanization and natural reforestation have reduced the total area of fertile land available, the Federal Council supports agricultural producers by providing incentives for the acquisition of tools to limit permanent damage caused by land use, and it trains specialists who advise construction companies on large development projects (FDFA, 2020).

In addition to the measures stated, during the field visit, it was possible to collect testimonials and images from merchants, producers, and visitors to the region, and a following document is being prepared that specifically states how the environmental sustainability criteria are met in the region: what are the challenges for its application and what have been the learnings and; on critical spaces for reflection, it is expected to have results by the end of this year.

Conclusions

Although it is possible to think that countries like Mexico are far removed from environmental protection conditions such as those shared in this article, it is important to mention that the great environmental measures in Switzerland were only adopted at the end of 1986, when a fire broke out in a Warehouse belonging to the chemical company Sandoz in the Schweizerhalle industrial zone, on the outskirts of Basel.

Around 1,351 tons of pesticides and agrochemicals were burned when "...this accident painted the Rhine River red, killed thousands of fish and engulfed the city in acrid smoke. It was one of the worst environmental disasters in Europe and made global headlines" (swissinfo.ch and agencies, 2016).

Similarly, in Switzerland there are still challenges to comply with the laws, but, learning about real cases where ways of action have been found despite the challenges, invite us to think ambitiously in the future, especially when witnessing the excessive loss of territory of countries that have devastated a portion of its biodiversity and natural resources in ecocides of unfortunate magnitudes.

A large part of the problems that nations face to take care of their resources is due to irresponsible socioeconomic processes, causing to a great extent the discouragement of those who fight for the environment, since the demands for protection face situations aggravated by poverty, lack of vision long-term and viable technological and productive alternatives, and even to political or business interests that have led to the overexploitation of natural resources.

Finally, the reason for insisting on issues such as the one presented here is the conviction that respect for the environment improves quality of life, preserves biodiversity, and helps promote ecological tourism. In fact, the Federal Office for Territorial Development has identified the landscape as one of the key factors in any development project (FDFA, 2020).

At a time when nature tourism takes precedence over any other project, including those that have to do with energy, industry, or transport, it is essential to respect and protect the landscape and resources by and for the inhabitants of the present and future generations.

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Obtaining particulate agglomerates from the recycling of multilayer containers and PET/AI/PE

Obtención de aglomerados particulados a partir del reciclaje de envases multicapa y PET/AI/PE

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Abstract

Sustainability makes the final use of waste reconsider, if it is possible to give it a new use and thus contribute to the planet. Therefore, in this work the physical and mechanical properties of particulate agglomerates from the recycling of multilayer containers (EM) and powdered milk (EL) are evaluated, the w/w ratio was varied. Agglomerates with a homogeneous matrix are obtained, hard to the touch, light, they can be cut, drilled, they are fireproof, they all have a prolonged elastic zone, when subjected to a load they do not show rupture, they support loads of 12 MPa. As the amount of EL increases, the density of the agglomerate increases and the apparent density decreases due to the compressibility of the materials, which contributes to reducing the degree of hygroscopicity. There is no relationship between the density and the properties of the agglomerates. The material that complies with the NMX-C-013-1978, ASTM D 1037-12 and NMX-C-036-ONNCCE-2013 standards, is the one with a p/p ratio of 70:30 (A6), it can be used in construction as a false wall; both outdoors and indoors. The other agglomerates could be used as catalytic supports for the degradation of dyes; because they show dimensional stability when in prolonged contact with water.

Sustainability, Particulate agglomerates, Catalytic supports

Resumen

La sostenibilidad hace que se replante el uso final de los residuos, si es posible darles un nuevo uso y así contribuir con el planeta. Por eso, en este trabajo se evalúan las propiedades físicas y mecánicas de aglomerados particulados a partir del reciclaje de envases multicapa (EM) y de leche en polvo (EL), se usaron diferentes proporciones p/p. Se obtienen aglomerados con matriz homogénea, duro al tacto, ligeros, se pueden cortar, taladrar, son ignífugos, todos poseen una zona elástica prolongada, al ser sometidos a una carga no muestran ruptura, soportan cargas de 12 MPa. Al aumentar la cantidad de EL aumenta la densidad del aglomerado y disminuye la densidad aparente debido a la compresibilidad de los materiales lo que contribuye a disminuir el grado de higroscopicidad. No existe una relación entre la densidad y las propiedades de los aglomerados. El material que cumple con las normas NMX-C-013-1978, ASTM D 1037-12 y NMX-C-036-ONNCCE-2013, es el de la relación p/p es 70:30 (A6), puede ser usado en la construcción de muro falso; tanto en el exterior e interiores. Los demás aglomerados podrían ser usados como soportes catalíticos para la degradación de colorantes; debido a que muestran una estabilidad dimensional al estar en contacto prolongado con el agua.

Sustentabilidad, Aglomerados partículas, Soportes catalíticos

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Introduction

Poor disposal of urban solid waste (RSU), due to the fact that collection and disposal are not carried out efficiently; brings environmental and health risks to the city (Tchobanoglous, H., & Vigil, 1996), (Lechuga M. & Vargas H., 2016). That is why the initiative to do something with these types of waste arises, such as recycling (Raza C. & Acosta, 2022).

Being an initiative in academic and administrative areas, waste collection, recycling 77,447 kg of recoverable waste: 7,099 kg of PET containers, 12,829 kg of multilayer containers, 171 kg of aluminum cans, 10,487 kg of glass, 26,361 kg of paper and 20,500 kg of cardboard (Espinosa, y otros, 2013).

The waste is used in 32% of the total waste generated in high volume and 67.2% is sent to final disposal sites; that is 1,177.61 kg/day and 429.83 tons/year are recovered from PET, multilayer containers 591.80 kg/day and 216.01 tons per year, aluminum 290.58 kg/day, 106.06 tons/year, magazines and cardboard 4987.45 kg/day and 1820.42 tons /year (AICM, 2010).

Unfortunately, solid waste, such as multilayer packaging, is not fully used; In the world, more than 89,000 million cartons are produced for Tetra Pak beverages and it reports that they distribute 140 million liters of packaged beverages worldwide (UAM, 2009).

As of 2003, it is estimated that, in Mexico, every year 150 million portions of milk packaged in aseptic tetra brik are distributed to children, almost 3 million Tetra pak packages are consumed per day (Leander , 2003).

Local governments and businessmen have promoted the use of post-consumer packaging for the manufacture of panels, which can be used in the manufacture of furniture and construction of houses, for environmental protection (Chung, 2003).

Therefore, studies are beginning to be carried out on the use of these panels obtained by recycling wood or other materials, which can be reinforced, in order to replace wood as raw material (Center, 2018).

The company Primadera in Colombia uses urban wood or wood from recycling as raw material, contributes to caring for the environment and generates a positive social impact (Primadera, 2016).

In 2017 the physical-mechanical properties were determined and evaluated with the German standards German Institute for Standardization (DIN) and Venezuelan Vensolanza Commission of Industrial Standards (CONEVID) the manufacture of chipboard using *Eucalyptus urophylla* wood, complied with the MOR and adhesion properties, but the percentage of moisture absorption and thickness variation in some cases did not comply with the maximum values accepted by the standards, so they can be used in internal parts of furniture and cabinets, decorative material superimposed on other materials (Rangel L. , Moreno, Trejo, & Valero, 2017).

In 2019, they used ebony wood sawdust and adhesive (obtained from the shavings of a dye in leather tanning) in different proportions, they obtained a very resistant agglomerate for construction and represents an eco-friendly solution for the final disposal of the shavings (Valdez U., González G., Pariguana B., Lopez Guerra, & Dueñas, 2019).

In 2021, agglomerates were made with multilayer containers, they are reinforced with PEBD in different proportions, p/p, the physical-mechanical properties were evaluated, the materials obtained present a homogeneous matrix, they can be used in closed or open places for the construction of walls, are light, easy to machine, absorb 14.2% when submerged in water (Enríquez, Rosales, & Castrejón , 2021).

Also, the mechanical properties of agglomerates of multilayer containers reinforced with low-density polyethylene (PEBD) and polyethylene terephthalate (PET) post-consumer (ratio w/p 90:10) have been evaluated, the compaction and integration between the materials were improved and the density, decreases water absorption and volumetric variation; therefore, they are ecological agglomerates, do not generate waste and contribute to reducing RSU (Enríquez & Rosales, 2021).

In this work, two types of RSU are being combined, powdered milk containers (polyester/aluminium/polyethylene PET / Al/PE) and multilayer containers (cardboard, polyethylene and aluminum), controlling physical variables such as: temperature, pressure and time in the thermoforming process, for the elaboration of agglomerates of dimensions 24*12*2 cm, in addition the resistance to compression is analyzed, for its possible use in the construction of interior and exterior walls in homes, ceilings or false walls in residential houses or as catalytic supports for the degradation of pollutants. Contributing to reduce RSU, environmental risks and ecological aspects.

Methodology

For the elaboration of particulate agglomerates, multilayer containers (EM) and powdered milk containers (EL) were collected, washed and dried at room temperature.

The raw material is crushed with a mill, until a particle size of 5 mm EM and 1 cm EL; subsequently, the raw material is weighed. Table 1 shows the proportions w/w that were experimented to obtain the agglomerates.

Agglomerate	% EM	% EL
A ₁	95	5
A ₂	90	10
A ₃	85	15
A ₄	80	20
A ₅	75	25
A ₆	70	30

Table 1 Variation p/p between EM and EL
Source: Own Elaboration

The raw material is placed inside a mold with dimensions of 24*12*2 cm, which functions as a hot plate for thermoforming, manipulated by a control system. In thermoforming, agglomerates are obtained under the following operating conditions: heating time 60 min, pressure 4 tons of axial compression at 180°C; then the agglomerate is cooled to room temperature and removed. The described procedure has already been previously reported (Enríquez Pérez, Rosales Davalos, López Ramirez, & Castrejon Sanchez, 2017).

The physical-mechanical properties were carried out using the Standard NMX-C-013-1978 Plasterboard for dividing walls, ceilings and fire protection, ASTM D 1037-12 Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials and Standard NMX-C-036-ONNCCE-2013 establishes the test method for the determination of the resistance to compression, applicable to blocks, partitions or bricks, partitions, lattices and paving stones of national manufacture and of import, that are marketed in national territory.

Analysis of results

The agglomerates are light materials, with a homogeneous matrix, hard to the touch, compact, with an average weight of 0.5 kg, figure 1 shows the physical appearance of the material.

The appearance of the material depends on the material used in the matrix and reinforcement, so that they can be integrated into a homogeneous matrix (Enríquez Pérez, Rosales Davalos, López Ramirez, & Castrejon Sanchez, 2017); the reinforcement used allows a good integration of the material regardless of the proportions.

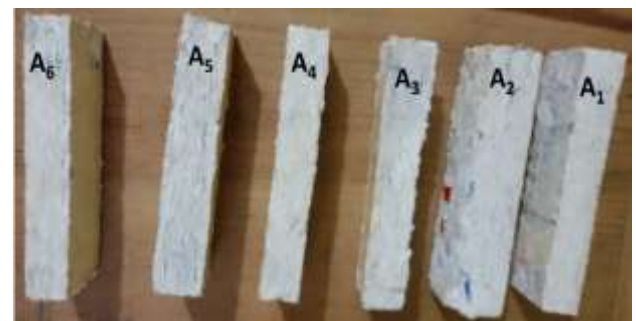


Figure 1 Appearance of the agglomerates
Source: Own Elaboration

Table 2 shows the density of the materials obtained, when reinforcing them there is an increase in weight.

Agglomerate	Density Kg/m ³
A ₁	620.9
A ₂	775.9
A ₃	756.1
A ₄	873.2
A ₅	905.8
A ₆	915.1

Table 2 Density of the agglomerates.
Source: Own Elaboration

In figure 2, the density vs relative humidity is plotted; as the density increases, the humidity decreases, the higher the weight there is a better compressibility between the material and the reinforcement, which contributes to reducing the degree of hygroscopicity (Zambrano, y otros, 2013).

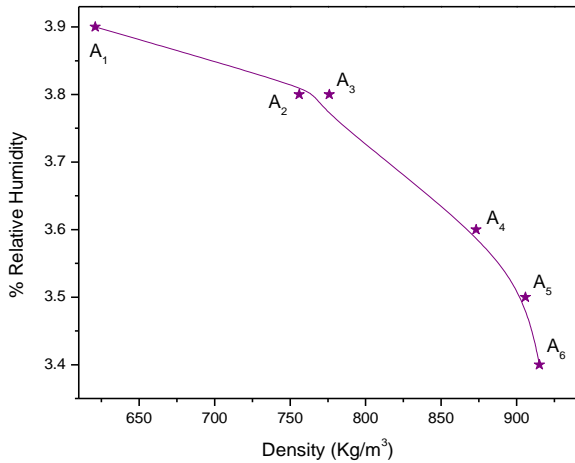


Figure 2. Percent Relative Humidity
Source: Own Elaboration

The water absorption is determined, when the material is submerged in water, for a period of time, in accordance with the ASTM D 1037 standard. Figure 3 shows the evolution of water absorption as a function of time (hours).

Some authors (Moreno P., y otros, 2005) (Zambrano, y otros, 2013), (Rangel, Moreno, Trejo, & Valero, 2017), assure that the increase in the density of the agglomerates produces a decrease in the absorption of water; this behavior is not presented by the materials obtained.

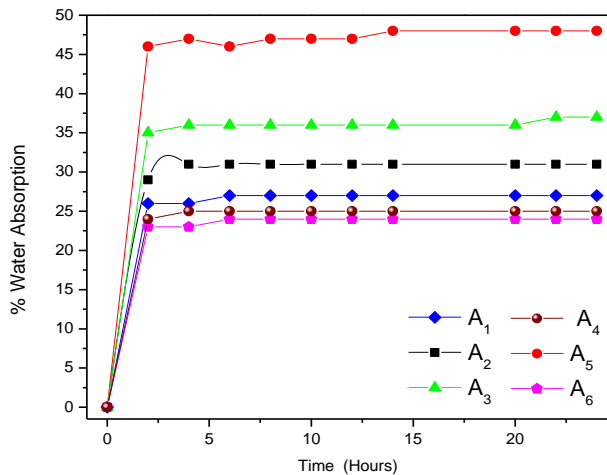


Figure 3 Percentage of water absorption.
Source: Own Elaboration

In the first two hours, the material absorbs the greatest amount of water, in a range from 23% to 46%, after that time there are no major variations in the percentage. This stability occurs when the agglomerates have little porosity and a good interaction between the particles and the reinforcement, which prevents the penetration of water (Rangel, Moreno, Trejo, & Valero, 2017).

Only A4 and A6 comply with the ASTM D 1037 standard, which indicates that the agglomerates can have an absorption between 25 and 60% between 2 and 24 hours. However, all comply at 24 H. Both A4 and A6 can be used outdoors, the others can be used indoors or as catalytic supports in the degradation of dyes (Enriquez P., Castrejon S., Rosales D., & Mendez R., 2019).

Figure 4 shows the variation of volume vs. time of immersion in water. The volume increase of the agglomerates ranges from 2.0 to 23.1%. When you have values lower than 30%, you do not reach a saturation of the fibers, so there is only an increase in weight, the volume remains practically constant (Volcuende, Parra, & Benlloch, 2005).

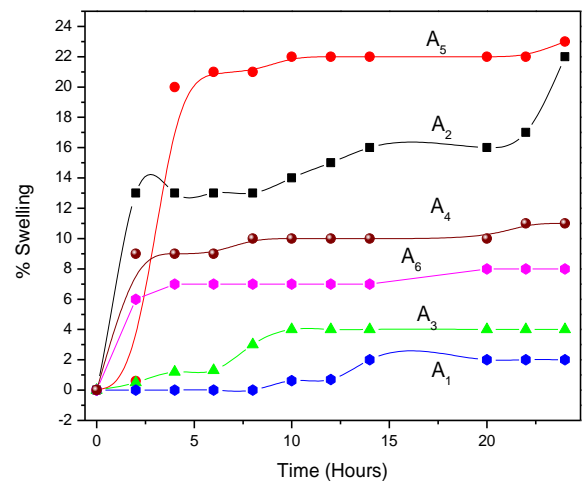


Figure 4 Swelling percentage
Source: Own Elaboration

A5 was the material with the highest water absorption; therefore, it presents the greatest swelling. However, this tendency is not possessed by the other agglomerates, there is no correlation between swelling and density. The volume change in materials is not observed with the naked eye.

The standard requests a variation of no more than 6% and 15% at 2 hours and 24 hours. The A₁, A₃ and A₆ comply with the standard. The material was dried in the sun, after three days under the sun's rays, they recover their initial weight, eliminating the absorbed water, without modifying their physical characteristics.

Table 3 shows the results of the compression test. All the blocks meet the required resistance according to the NMX-C-036-ONNCCE-2013 Standard, so they could be used as false walls. There is no relationship between density and strength in the material.

Aglomerate	Force	
	Kg/m ²	MPa
A ₁	122.1	11.98
A ₂	122.4	12.00
A ₃	122.0	11.97
A ₄	122.2	11.99
A ₅	122.4	12.01
A ₆	122.3	11.97

Table 3 Compression test
Source: Own Elaboration

The material has good resistance to deformation, they have a prolonged elastic zone, when subjected to a load they do not show rupture, on the contrary, they have shape memory, when the load is removed after half an hour they return to their dimensions originals (see figure 5).



Figure 5 Appearance of the agglomerate after subjecting it to the compression test
Source: Own Elaboration

The agglomerates, independent of their composition, are: hydrophobic, fireproof, they do not spread heat, they only carbonize. They can be cut and tied, they support plugs, screws and nails, without presenting alterations in their structure.

Conclusions

In obtaining particulate agglomerates, the combination of EM and EL increases the cohesion of the material; by increasing the proportion of ELs, the density of the material increases and the relative humidity decreases; therefore, the compressibility between the matrix and the reinforcement is increased.

All the agglomerates comply with the NMX-C-036-ONNCCE-2013 standard; although not all comply with the ASTM D 1037 standard, which limits its use in construction. But, they are an alternative material to be applied as a catalytic support in the degradation of dyes. Because they can be cut, sanded, drilled, painted, submerged in water and exposed to the environment, without suffering a physical alteration.

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Validation of a pulp-type candy (Pulpijamay) based on the by-product of the hibiscus flower (*Hibiscus sabdariffa*)

Validación de un dulce tipo pulpa (Pulpijamay) a base del subproducto de la flor de jamaica (*Hibiscus sabdariffa*)

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Abstract

There is a diversity of sweets in confectionery according to times and countries, according to regions and religions where there is no limitation in the preparation of the sweet depending on the imagination of each confectioner. With the jamaica flower (*Hibiscus sabdariffa*) various food products are made and currently with pharmaceutical interest, certain products are attributed beneficial qualities in weight loss, favoring the digestive process in a good way, it is slightly laxative and is also diuretic, reason for which it has cleansing and detoxifying effects, despite these benefits, in general only the supernatant is used and the flower is discarded as organic waste. Therefore, in the present research work, it seeks the use of the pulp of the jamaican flower (*Hibiscus sabdariffa*) developing a sweet, carrying out tests with different binding substances and concentrations, obtaining samples of paste to later be mixed with sucrose, salt and chili pequin. The same procedure was carried out for gum arabic, glucose and the glucose-sucrose mixture. Physicochemical results were obtained from the product, such as pH, °Brix and the desired viscosity for the Jamaica flower candy.

Flor de Jamaica, Sweet, By-product

Resumen

Existe una diversidad de dulces en confitería de acuerdo a épocas y países, según regiones y religiones donde no existe una limitante en la elaboración del dulce dependiendo de la imaginación de cada dulcero. Con la flor de jamaica (*Hibiscus sabdariffa*) se elaboran diversos productos alimenticios y actualmente con interés farmacéutico, a ciertos productos le atribuyen cualidades benéficas en la pérdida de peso, favoreciendo de buena manera el proceso digestivo, es ligeramente laxante y además es diurética, razón por la cual tiene efectos depurativos y desintoxicantes, a pesar de estos beneficios en general solo se utiliza el sobrenadante y la flor se desecha al medio como residuo orgánico. Por consiguiente, en el presente trabajo de investigación busca el aprovechamiento de la pulpa de flor de jamaica (*Hibiscus sabdariffa*) desarrollando un dulce, realizando pruebas con diferentes sustancias ligantes y concentraciones, obteniendo muestras de pasta para posteriormente ser mezcladas con sacarosa, sal y chile piquín. Se realizó el mismo procedimiento para la goma arábiga, la glucosa y la mezcla de glucosa-sacarosa, del producto se obtienen resultados fisicoquímicos como son el pH, los °Brix y la viscosidad, que se deseaba para el dulce de flor de jamaica.

Flor de jamaica, Dulce, Subproducto.

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Introduction

The development of confectionery in the world is closely linked to the use of sugar and sugar beet. This art dates back 3500 years, as demonstrated in Egyptian writings and in the Herculanium ruins, where a workshop was found with utensils similar to those of today. Confectionery products are considered to be those made with cane sugar, beet sugar and other edible sugars (glucose, fructose and destroza) added to foodstuffs such as flour, eggs, chocolate, fat, oils and fruit juices (Zamorano, 2008). The variety in confectionery confectionery is enormous, it changes according to times and countries, even regions and religions, and there is no limitation in the preparation of sweets, depending on the imagination of the confectioner.

There are three types of confectionery: a) bakery confectionery, b) sugar confectionery and c) chocolate confectionery. Sugar confectionery is further divided into two groups:

1) with sugars that are in non-crystalline form and 2) with all crystallised sugars. Confectionery containing non-crystalline sugars includes those made with fruit, glucose syrup and sucrose as main constituents, as well as a gelling agent that serves to keep the syrup more solid. Such agents can be starches, agar, alginates, pectins with the addition of water, examples of which are jams, jellies and pulp enchiladas (Kerstupp *et al.*, 2001). Examples of sweets containing non-crystalline sugar are: hard candies, nougats, jams, fruit jellies, pastilles, gums and caramels and of crystallised sugar are fondans, fudges, marzipan, praline pastes, coated products, compressed tablets and crystalline nougats.

The objective of the research work is to take advantage of the by-product of the hibiscus flower (*Hibiscus sabdariffa*), which has attracted attention due to its nutritional characteristics, which provide a series of benefits in its consumption, such as: aid in the digestive process, laxative, diuretic, depurative, detoxifying, weight control, among others. The proposed area of opportunity is to take advantage of the pulp of the hibiscus flower, which is currently considered an organic waste product.

This value proposal consists of using this resource as the main raw material in the production of a sweet and sour, sweet and sour pulp, which would represent an innovation in the sector, producing a sweet from a by-product, thus giving added value, presenting an alternative consumption that can open up a new market, providing quality caloric intake, because it will not have chemical preservatives.

The structure of this article consists of the following points:

- A theoretical basis in which the characteristics of the hibiscus flower are provided, as well as information on the by-product of the same, in which its use is proposed to elaborate a pulp type sweet, within the theoretical outline the binding properties are also pointed out; such as sucrose, glucose and gum arabic.
- Continuing with the materials and methods, where the processing of the raw material is specified, providing its statistical analysis and methodology to be developed. Preliminary results of the physicochemical characterisation and sensory analysis (colour, appearance, consistency and flavour) are presented, and finally a discussion of results and conclusions is generated.

Based on the studies carried out, the following question is formulated: Does the sweet based on the by-product of the hibiscus flower (*Hibiscus sabdariffa*) meet the consumer's expectations?

1. Theoretical basis

The circular economy aims to valorise food biowaste such as hulls, seeds, stems, roots, pulp remains, bagasse, because they retain a high content of bioactive molecules. These by-products could be used as industrial raw materials (Gómez *et al.*, 2021), as in this case the dried calyxes of hibiscus (*Hibiscus sabdariffa* L.) are generally used in the production of beverages, generating an extract with abundant organic acids, polysaccharides, phenolic compounds, flavonoids and anthocyanins with diverse pharmacological and antioxidant activities.

And at the same time a residue is generated as a by-product that preserves up to 50% of the same biologically active compounds of the extract, with a high content of dietary fibre (14.6 %) (Amaya *et al.*, 2017), where it can be used as a food ingredient due to its organoleptic characteristics, representing an alternative in the production of confectionery, candy pastes, coated products, jellies, among others.

The hibiscus flower (*Hibiscus sabdariffa*) belongs to the malvaceae family, better known as hibiscus rose or abyssinian rose, it is a shrub that can grow up to three metres (m) high, its flower is red thistle and has five to seven petals. The plant is an annual, it grows best in regions with tropical and subtropical climates, it is cultivated in the spring-summer season and harvested from October to November, although it can grow in arid climates.

The calyxes, or crimson-coloured fruit, are marketed in dehydrated form for the preparation of fresh drinks and infusions and is the product we commonly consume. On the American continent, Mexico is the main producer with 27.76 percent of world production, with 40 municipalities in 11 states: Campeche, Colima, Guerrero, Jalisco, Mexico, Michoacán, Morelos, Nayarit, Oaxaca, Puebla and Sinaloa.

The state with the highest production is Guerrero with 73.64 per cent; Ayutla, one of its municipalities, contributes 44.99 per cent of the national production (SIAP, 2019). The crop is a rainfed crop, sown by seed from June to August in soils with low fertility and low moisture retention, pest and disease control is minimal and harvesting is done manually, hence its social importance.

The composition of the calyxes of the hibiscus varies according to colour and genetic differences. The calyxes contain: anthocyanins 1.5 percent, organic acids 15-30 percent, mucilaginous polysaccharides 50 percent, flavonoids, saponins, phytosterols, pectin and fibre. Organic acids and anthocyanins have been shown to have antimicrobial and antioxidant activity. All these components have good bioavailability (Duke *et al.*, 2003).

Hibiscus flower contains various compounds including alkaloids, ascorbic acid, anisaldehyde, anthocyanins, β -carotene, β -sitosterol, citric acid, malic acid, galactose, mucopolysaccharides, pectin, protocatechuic acid, polysaccharides, quercetin, stearic acid and wax (Hirunpanich *et al.*, 2005). Beyond this, the wide range of substances that make up hibiscus gives it a large number of biological activities and positive health effects.

The hibiscus flower originated in India and has since been distributed to the tropics of the New World, probably brought from Africa to America by slaves. It has been intensively cultivated in the tropical and subtropical regions of India, Thailand, Senegal, Egypt, the United States, Panama and Mexico (Fellows & Hampton, 1992). Hibiscus is currently cultivated in the states of Campeche, Colima, Guerrero, Jalisco, Michoacán, Nayarit, Oaxaca, and Puebla, see figure 1.



Figure 1 Hibiscus flower (Source/ Own)

The hibiscus flower is used to make various food products and nowadays it is even of pharmaceutical interest. Hibiscus flower tea is one of the products that has been widely used for many years and currently has been attributed various qualities, one of which is that it can be beneficial for weight loss, as it favours the digestive process, is slightly laxative and is also diuretic, which is why it has depurative and detoxifying effects, including for treating cholesterol, triglycerides, hyperlipidemia and the kidneys; In the food sector, hibiscus jams are also made, which is a molasses obtained from hibiscus concentrate and mixed with the ground flower, which has a sweet and sour taste and a smooth consistency (Salazar & López, 2009).

However, although the use of hibiscus flower is very wide and abundant, it is observed that the food industry, restaurants and cafeterias, etc. have only used the infusion to make the aforementioned products, discarding the organic residue of hibiscus flower into the environment, where it can be reused and given added value. As a result of this, a proposal was developed in which the hibiscus flower by-product was considered to make a sweet, in such a way that tests were carried out with different binding substances and concentrations, in order to properly establish the processing technique of the paste and obtain a product with better viscosity, and the microbiological quality of the sweet was also determined.

Due to its functional components, it is used in traditional medicine as an alternative for the treatment of the circulatory system, high blood pressure, cholesterol, diabetes, obesity, colds, coughs, as a diuretic, for its antioxidant properties, and in the development of anticarcinogens. Supplements containing hibiscus with other antioxidants, vitamins or lactobacilli are currently available and are marketed as food supplements. For their part, (Guardiola & Mach, 2014) demonstrated the therapeutic effect of hibiscus extracts, thanks to their composition rich in phenolic compounds, on oxidative stress, lipid profile, hypertension and atherosclerosis. The flowers contain several natural antioxidant compounds that also act against various viruses and bacteria. Hibiscus acid and its derivatives can be sterilised and stored at room temperature. Their stability allows them to be applied in food, pharmaceutical, agricultural and cosmetic products, because they are a potential alternative in the control of multi-resistant pathogenic bacteria such as Salmonella and E. coli (Portillo *et al.* Coli (Portillo *et al.*, 2019).

The basic principles for the production of confectionery are the realisation of a material balance for the formulation, preparation and mixing of the ingredients, the concentration of the mixture to the desired temperature, cooling, moulding, as well as its packaging. Factors affecting the production and storage of confectionery include: the degree of sugar inversion, time, temperature, concentration, residual moisture in the confectionery and the addition of other ingredients. (Fellows & Hampton, 1992).

According to CODEX STAN 296-2009, for jams, jellies and marmalades that are intended for direct consumption, including for catering use or for repackaging if necessary, this standard applies. It defines jellies as the product prepared from the juice and/or aqueous extracts of one or more fruits, mixed with foodstuffs that impart a sweet taste, with or without the addition of water and processed to a semi-solid jelly-like consistency (STAN, 2009).

By-product

Among other uses of *hibiscus sabdariffa*, it is used to prepare infusions as tonics, laxatives, which are used to reduce fever, as well as in chewing gum products; the flower together with the leaves have emollient, diuretic laxative and anti-inflammatory effects similar to those of phenyl butazone, the calyx and flower are used to preserve, tan and produce jellies and juices as well as products with a viscous consistency (Bata & Santhankumari, 1991).

In the fruit and vegetable industry, larger quantities of residues are generated from the processing of fruits or vegetables, attracting particular attention as economical, functional and novel ingredients. However, currently these types of waste are used as fertiliser, substrate in biogas production, some are disposed of in landfills or even incinerated causing additional cost to the producer, generating an environmental and economic impact, thus a loss of valuable nutrients (Angulo *et al.*, 2012). In view of the trend towards more sustainable and healthier production systems, the food industry is looking for effective proposals in these by-products or "bio-waste" in such a way that it can provide the waste with an added value that helps to reduce the environmental impact caused by its disposal in the process in which it was used (May & Guenther, 2020).

An example is the soft fruit juice industry in general, during the processing to obtain juice, a solid residue called press cake, pomace or bagasse is obtained, representing 20-30 % of the total berry (Muceniecea *et al.*, 2019). This by-product could be an attractive alternative source of valuable bioactive compounds due to its low cost and biorenewable nature, and could be very interesting within food product innovation due to the recovery of value-added ingredients it can present (Struck *et al.*, 2016).

Composition as the development of new methods of waste valorisation, helps to convert bagasse from soft fruits into products with high value for potential use in the treatment or prevention of chronic diseases (Muceniecea *et al.*, 2019). The use of by-products is increasingly widespread in the food industry, forming part of the final food composition, not only because of the nutritional benefits they present, but also because they show diverse uses as food additives, providing colour to the final product, or as antimicrobial agents to improve shelf life..



Figure 2 By-product of Hibiscus Flower (*Source/ Own*)

The incorporation of bagasse has several applications, among which are, on the one hand, fortification (addition) and on the other hand, the substitution of some ingredient of the composition in the original product (Figure 2); in both cases, changes are produced in the composition of dietary fibre, vitamins and phenolic compounds of the product. Despite the fact that their incorporation may influence by modifying certain physical and technological properties of the original product, it also allows endowing the product with numerous effects such as controlling and reducing blood sugar release, counteracting peaks of hyperglycaemia (hypoglycaemic effect) or reducing the risk of suffering from certain cardiovascular diseases (Quiles *et al.*, 2018) (Tańska *et al.*, 2016).

Recent studies show the potential use of bagasse from soft fruits in different food products, providing all of them with added value due to the fact that it is a rich source of natural phytochemical compounds. However, given the variability of foods in which it can be included, it exerts a different effect on each of them.

As in the case of bakery products and meat products, it extends the shelf life of the food as a result of its antioxidant role, preventing the development of unpleasant odours or flavours, a consequence of lipid oxidation, and therefore helps to combat altering pathogenic microorganisms. Finally, in dairy products, it has an antioxidant and physiological effect on patients with diabetes, reducing blood glucose levels. Each application requires a thorough investigation of the possible level of bagasse incorporation to produce foods with satisfactory sensory properties. To achieve this goal, adaptation of the product formulation or manufacturing process may be necessary. Bagasse from the soft fruit industry is therefore an interesting opportunity to improve waste management and to obtain foods with ingredients high in dietary fibre and phytochemicals.

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Binding properties

The term gums is used to refer to polysaccharides or their derivatives, obtained from plants or by microbiological processing, which, when dispersed in cold or hot water, produce viscous solutions or mixtures (Whistler & Daniel, 1985).

The food processing industry, as well as other industrial applications of gums, take advantage of their physical properties, especially their viscosity and colloidal structure. At the same concentrations, gums with relatively linear molecules, such as gum tragacanth, form more viscous solutions than spherical shaped gums such as gum arabic for example (Considine & Considine, 1983); they are generally used in a concentration range between 0.25 to 0.50% which shows their great ability to produce viscosity and form gels (Bemiller & Whistler, 1996).

Sucrose

The specific property of sucrose is its ability to split or invert, resulting in a mixture of equal parts of glucose and fructose, i.e. invert sugar. This process depends on factors such as pH, temperature, cooking time, size of molecules in solution and water hardness, and occurs in cooking processes of slightly acidic syrups. This property represents one of the major problems in the confectionery industry, because if not properly controlled, it leads to a shorter shelf life at temperatures above 32 °C and relative humidities below 70%. Sucrose is a carbohydrate with a very high solubility capacity, which has an impact on other properties including confectionery production processes in general.

Glucose

Glucose is also called dextrose because of its dextrorotatory capacity, defined as the most important molecule in nature, it can be found in various forms, it is the basis of starch, cellulose, glycogen and forms part of sucrose, it is found free in fruits and in honey. It is a less sweet sugar than sucrose, an interesting property of this monosaccharide is the effect of freshness that provides when taken to the mouth, this feature is used for the production of various confectionery products such as: tablets, sweet and sour powders, chewing gum, or as ingredients in the partial replacement of sucrose as it is a carbohydrate that provides half of the caloric intake; sucrose is used in reduced calorie products, its presence in formations intensifies Maillard reactions and increases softness and hygroscopicity in confectionery products (Marshmallows).

Gum Arabic

Known as gum acacia, considered the best of the gums, it is the sap exuded from various species of acacia trees. Chemically, gum arabic is a neutral or slightly acid salt of a complex polysaccharide containing calcium, magnesium and potassium ions in its molecule; and is made up of six carbohydrates: galactose, rhamnose, arabinopyranose, arabinofuranose, glucouronic acid and 4-o-o-methylglucouronic acid (Prakash & Manguino, 1990). This gum is a heterogeneous material in terms of the protein that is part of the structure.

Gum arabic dissolves rapidly in cold or hot water, the least viscous and most soluble of the hydrocolloids (Dziezak, 1991), noting that more than half of the gum arabic produced in the world is used in the preparation of sweets and confectionery, in order to retard the crystallisation of sugar and promote emulsification; The flavour industry uses gum arabic as a fixative and encapsulant to avoid oxidation and volatilisation of its components, while in beer brewing it promotes foam stabilisation; and due to its protein component, this gum is used as an emulsifier.

It is currently used to improve chewing, it is a means to fix flavouring preparations and as a Millard agent, when applied as the only colloidal ingredient, solutions should be prepared at 40-50% by weight and when used in combination with other agents, this proportion should be adjusted to the requirements of the formula (Ramírez & Orozco, 2014).

°Brix and pH

The concentration of sucrose solutions can be measured by the refraction of light through the solution. When a solution contains more sugar, its refractive index will be higher. It is advantageous to measure the concentration by means of a refractometer to save time and effort. Based on the principle of refraction, the Brix degree has been introduced to express the concentration of sucrose solutions. The Brix degree is only defined at a temperature of 20 °C. At this temperature, Brix is equivalent to the weight percentage of sucrose in an aqueous solution.

In practice, aqueous solutions are classified as acidic if the pH is less than 7.0, basic if the pH is less than 7.0 and neutral if the pH is equal to 7.0.

Materials and methods

Raw material processing

In the facilities of the Instituto Tecnológico Superior de Villa La Venta (ITSLV), the pulp was processed. Subsequently, a quantity of hibiscus flower by-product was used, firstly performing a visual inspection of the hibiscus flower to verify its colour, smell and size, checking that it did not show artificial colouring, and then removing any debris or foreign bodies, after which it was rinsed with purified water.

Once the flower was cleaned, it was immersed in purified water at 95 °C for 10 min. After this blanching process, the flower was separated from the supernatant with a strainer. With an industrial type blender, the hibiscus flower (leftover) was processed with water in quantities (1:50) for 15 min. until a homogeneous and smooth paste was obtained. Once the paste was obtained, it was placed in a glass bowl and the following mixtures were made with sucrose, gum arabic and glucose as binders in the hibiscus flower paste. Nine samples of 150 g. were weighed and then mixed in triplicate with different amounts of sucrose, salt and piquín chili were added.). The sucrose was melted in a pewter pot and then mixed with the organic residue, adding the salt and the piquín chili, the mixture was homogenised until it reached a temperature of 110°C, allowing the consistency, allowing it to cool for 10 min. and then packaged in plastic cups. The same procedure was carried out for the gum arabic and glucose. In addition, a sucrose-glucose mixture was made and added to the paste, see (figure 3).

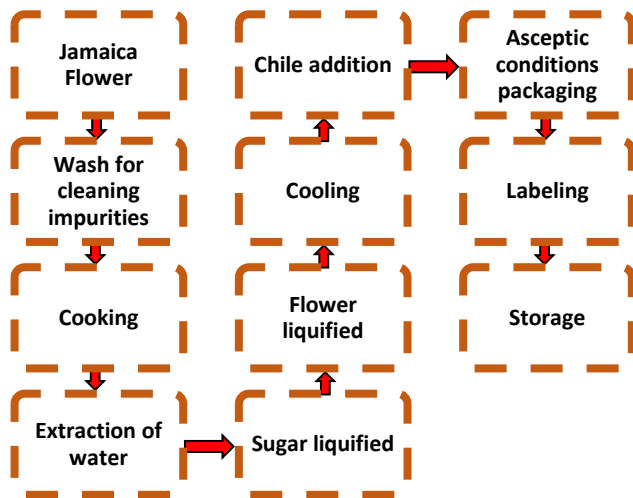


Figure 3 Diagram of the pulpjamay sweet process
(Author's own)

Once the mixtures to be analysed were obtained, samples were collected in triplicate and taken to the laboratory of the Instituto Tecnológico Superior de Comalcalco, Tabasco to determine physicochemical characteristics such as: pH, °Brix and viscosity. For the control of the different determinations and to obtain a quality product, it was compared with a control sample of a sweet similar to pelón pelo rico. The microbiological analyses were carried out according to NOM-111-SSA1-1994, goods and services, by the method of counting moulds and yeasts in foodstuffs.

Using the culture medium potato agar - dextrose, in dehydrated form using phosphate buffer solution and sown in Petri dishes, placed in an incubator for 5 days at a temperature of 27 °C.

Statistical analysis

In order to find significant differences between the viscosities of the candy pastes, ANOVAs were performed where variability was observed and a Tukey's a posteriori analysis was performed at $\alpha=0.05$. Statistical analyses were performed with STATISTICA ® version 8 (StatSoft, Inc.).

Preliminary results

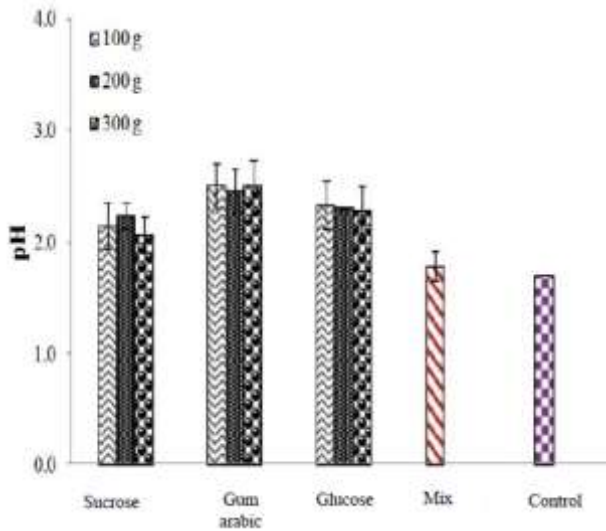
Physicochemical characterisation

In the determination of the pH parameter, these values showed significant differences ($P<0.001$), the gum Arabic indicated lower acidity, while the mixture and control samples showed higher acidity (Graph 1), with no significant differences between the two ($P=0.971$), which indicates that the mixture sample is the most similar to the control sample, which means that it is a sweet that provides the desired characteristics in the product.

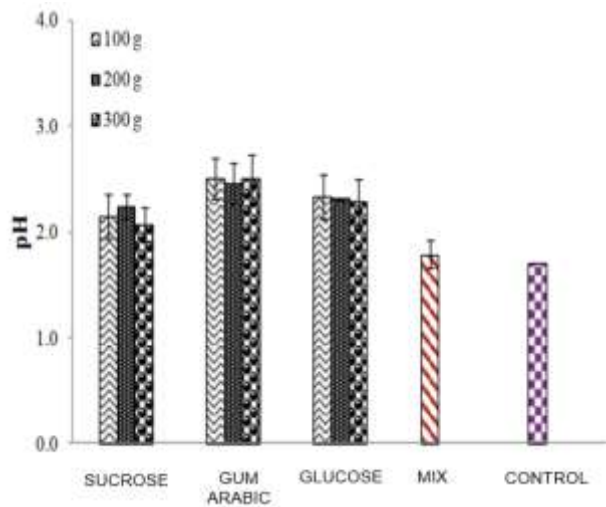
With respect to the °Brix these data showed significant differences ($P<0.05$) where the gum arabic does not indicate sugar levels (Graph 2), on the contrary, it is observed in the glucose mixture and control higher levels of glucose, without statistical differences between both ($P=0.996$). The effect of carbohydrate content with respect to °Brix was more evident with the sucrose sample, as an increase in this parameter was observed with respect to the grams used.

Viscosity was influenced by the type of carbohydrate added, obtaining significant differences ($P<0.001$), with the sucrose sample indicating higher viscosity, while the gum arabic sample indicated lower viscosity, but no significant differences were observed between the gum arabic, glucose and mixture samples (Graph 3).

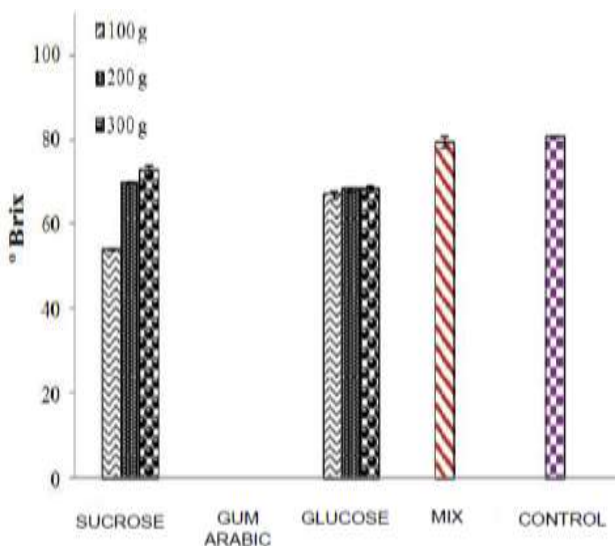
With regard to the microbiological results, no CFU (Colony Forming Units) of moulds or yeasts were found.



Graph 1 Average pH values with the different binders: sucrose, gum arabic and glucose with 100, 200 and 300 g of each, a sucrose-glucose mixture and the control. The bars indicate the standard deviation (Own Authorship)



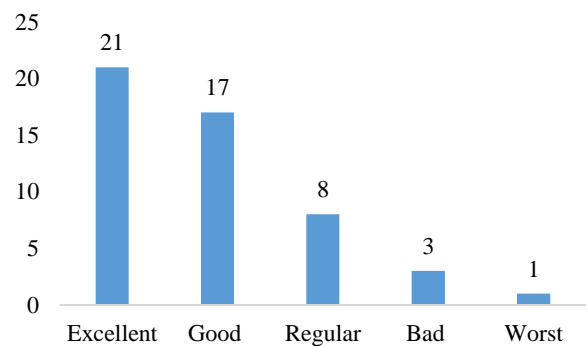
Graph 2 Average °Brix values with the different binders: sucrose, gum arabic and glucose with 100, 200 and 300 g of each, a sucrose-glucose mixture and the control. The bars signify the standard deviation.



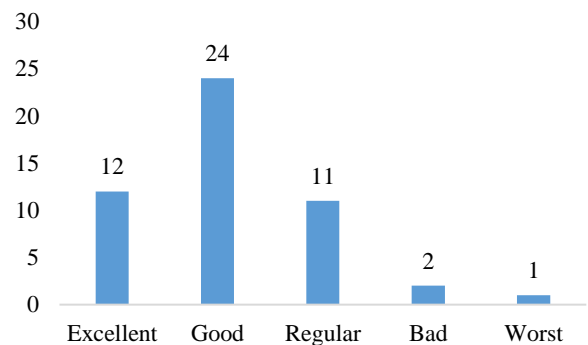
Graph 3 Average viscosity values with the different binders: sucrose, gum arabic and glucose with 100, 200 and 300 g of each, a sucrose-glucose mixture and the control. The bars signify the standard deviation

Sensory analysis of the pulpijamay sweet.

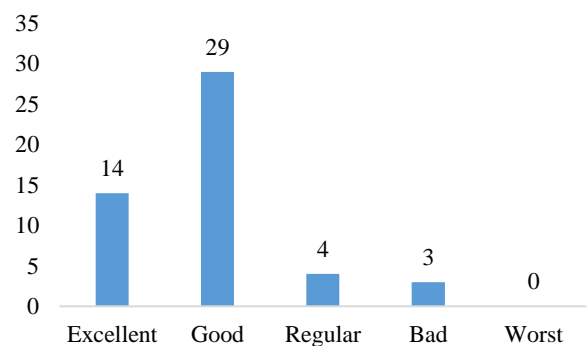
In the development of new products, sensory evaluation is important in order to be able to interpret consumer preferences (Anzaldúa, 1994). Therefore, a sensory analysis of the pulp was carried out, indicating its organoleptic characteristics such as colour, appearance, flavour and consistency, by means of consumer judges with hedonic scales, obtaining data represented in the following graphs:



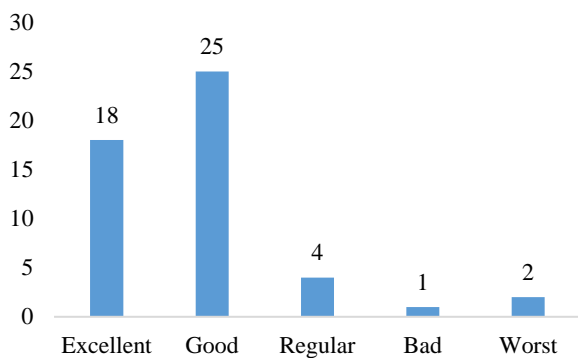
Graph 4 Sensory evaluation of the colour of the pulpijamay sweet Author's Own



Graph 5 Sensory evaluation of the appearance of the pulpijamay sweet Author's Own



Graph 6 Sensory evaluation of consistency of pulpijamay sweet Author's Own



Graph 7. Sensory evaluation of the taste of the pulpijamay sweet

Author's Own

Graph 4 of the sensory evaluation of the colour of the pulpijamay sweet shows the results obtained from the affective sensory tests carried out on consumers. Ninety-two percent of the people who carried out the test answered that they liked the colour and only 8% of the judges answered that they did not like it.

To continue in graph 5, the appearance is presented, which indicates that 24% is excellent and 48% represents that it is good, being within the taste of the judges. In graph 6, the evaluation of consistency registers 28% excellent, 58% good and only 6% bad; and to conclude in graph 7, the evaluation of taste, which is the most representative in a food, indicates 36% excellent and 50% good acceptance respectively.

Discussion of results

The results obtained show that the calyx of the hibiscus flower is the raw material for a by-product with commercial value in the market, due to the fact that the characteristics of a sweet to commercial product were obtained, in addition to the fact that when the sensory tests were carried out, this new product was widely accepted by the public, This suggests that the hibiscus flower can be used in a 100%, in such a way that agrees with previous works, where it is mentioned that can be obtained usable by-products mostly vegetables and fruits that have portions that are not used for human or animal consumption, and represent different percentages from 25 to 60% of inedible part; as in the case of some fruits with very thick skins or large seeds.

From the different treatments that were carried out with the hibiscus flower, it was determined that the viscosity that did not show significant differences with the control was the glucose-sucrose mixture, which indicates that this treatment was the binder that gave the new product the desired consistency.

Whereas gum arabic did not show a consistent viscosity due to its molecular structure, which does not allow it to give the products a high viscosity (Dziezak, 1991).

(Dziezak, 1991). As part of the results obtained, it can be said that the product obtained does not lose its characteristic aroma.

In relation to gum arabic, it is known that as it is a neutral polymer, it did not register °Brix (sugars), so it was used, looking for a suitable consistency.

However, the results were not encouraging, possibly due to the low pH and unsuitable viscosity. (Dziezak, 1991) mentions that chemically, gum arabic is a neutral salt, less viscous and is widely used in the manufacture of sweets and confectionery, with the aim of delaying the crystallisation of sugar.

In the case of sucrose, it showed 54.1 °Brix so that it registers a favourable viscosity and a pH of 2.14 is reflected, which is close to the required results and is also close to the characteristics of a desired product.

Finally, the glucose sample achieved the best results in the parameters obtained with a pH of 1.88 with 81 °Brix and a viscosity of 64200 centipoise, being this the best option, in this way it was foreseen to make the aforementioned mixture, fulfilling the desired, required and acceptable characteristics for the product.

(Durward, 2007) mentions that combinations of substances are necessary for the preparation of fruit jellies such as: pectin, citric acid, sugar and water, since the combination of these agents and substances is required within established limits.

As is known in this research, the results were determined with the combination of two types of binders that were the most appropriate to obtain the characteristics of the product in relation to viscosity, pH, °Brix, in the mixture, because this presented greater approximation with the control and it was not necessary to add pectin and citric acid, since the residues of hibiscus flower contains these compounds and are of great nutritional value to humans as they are: ascorbic acid, citric acid, malic, protocatechuic, stearic, and polysaccharides that retard the appearance and inhibition of microorganisms such as moulds and yeasts in the sweet, making it a natural additive.

The sweet does not present fungi and yeasts CFU/g in any of the studies carried out in terms of its microbiological activity; in the total count of the same indicates that there was no growth, which shows a clear stability of the product and sterility in storage conditions at room temperature.

(Cerezal & Duarte, 2005) mentioned that the sweetened pulp of the prickly pear in comparison with the jam showed results of mould and yeast CFU/g of $<1 \times 10^1$. There are related studies of hibiscus acetosella, which contain antimicrobial compounds that inhibit the growth of moulds and yeasts, so these compounds are also found in hibiscus sabdariffa, containing flavonoids, cyanidin, phenolic, polyphenols, anti-cyanins and carotenoids.

According to previous studies, hibiscus flower water is not rich in fibre, but it is favourable because it does not need artificial colouring and flavouring as other bottled waters are, where they are coloured and promise an unaltered quality of their main ingredient. The compound richest in fibre and antioxidant is the hibiscus calyx and the decoction residue, thus offering a high nutritional quality in this natural raw material. As a result of these studies, the interest in using a by-product of the hibiscus flower is justified, because of the great benefit it provides.

Conclusions

Through this research "Validation of a pulp type candy (Pulpijamay) based on the by-product of the hibiscus flower (*Hibiscus sabdariffa*)" it can be affirmed that it was possible to carry out the validation of the candy based on the by-product of the hibiscus flower (*Hibiscus sabdariffa*).

The mixture of glucose and sucrose with the hibiscus flower paste showed a greater similarity with the control (Pelón pelo rico) so that it was possible to decide for this mixture, due to the parameters of pH, °Brix and viscosity which are the most optimal characteristics for the quality of the product that was desired in a sweet based on hibiscus flower (*Hibiscus sabdariffa*), and also indicated in any of the tests to have good microbiological quality.

The analyses revealed no presence of microorganisms in the hibiscus flower by-product, which indicates that good safety and hygiene practices were followed during the production process.

In accordance with the objective, it was possible to obtain the expected results in terms of the desired paste viscosity with the combinations of different binders.

As a result, a new proposal for the use of the hibiscus flower by-product was obtained, thus contributing to the management and exploitation of this resource, giving it added value.

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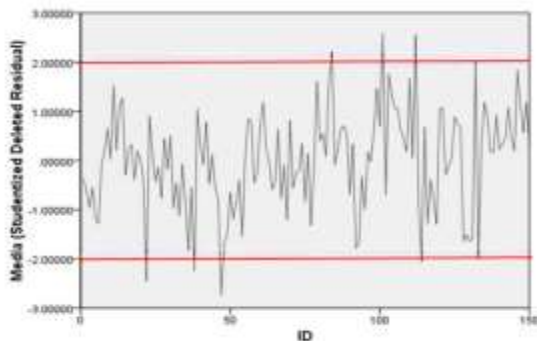
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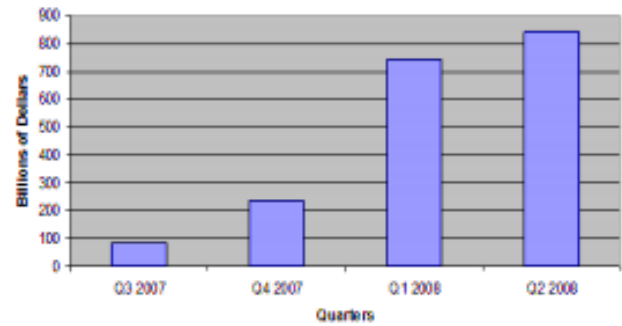


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