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Traditional mortars with chucum in Yucatan, Mexico, as biocultural heritage

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Abstract
The proposed presentation aims to characterize as biocultural heritage, the traditional construction technique of Mayan origin used to elaborate mortars with chucum (Harvadia Albi-cans) in Yucatán, Mexico. The aim is trying to keep alive the complex catalog of beliefs and traditions, the knowledge and productive practices specified in the materialization of the construction system whose origin is millenary. The study carries out the so-called "k-c-p complex (kosmos, corpus, and praxis)" which is used in ethnoecology in order to analyze documented information obtained in interviews with native teachers belonging to Mayan communities and construction surveys applied to current generations. The purpose is to increase its value to promote its safeguarding and its application in sustainable construction, conservation, and restoration of heritage buildings. Procedures are documented for the elaboration of the plant extract that would prevent the indiscriminate use of chucum in the industry. And finally, the importance of preserving learning scenarios to promote the transmission of traditional knowledge within indigenous people, for its future safeguarding is detailed.

Keywords: *constructive knowledge; mortars; chucum; biocultural heritage.*

1. Introduction

In the world, there are regions with great biological and cultural wealth. Many theorists call biocultural diversity the interconnection of these two spheres through the practices, traditions, and beliefs of indigenous peoples and traditional peasants. Lately, different organizations have highlighted the recognition, appraisal, and safeguarding of cultural manifestations and traditional knowledge of indigenous communities, and prioritize their participation in the conservation of their natural and cultural heritage.

Among the cultures that conform Mesoamerica region, Mayas stand out for developing a close relationship with its natural environment under sophisticated practices. An example of these activities and cultural practices is constructive knowledge.

Fig. 1. Vernacular architecture of Yucatán "Mayan house" (Source: Guerrero, 2021)

The notion in the Mayan language of this constructive knowledge is *U miatsil K'aax le naj* which refers to knowing how to "tie up" a Mayan

house because this is the origin of all the construction techniques used in this area (Sánchez, 2014). Mayan traditional constructive culture has been generated and transmitted through practice and language (Sánchez et al., 2021, p. 39). In constructive practice, there are cultural and cosmogonic connotations appreciable in their folkloric denomination, which are still present in memory and buildings. Palpable evidence of the cultural burden is found in Mayan murals, where there were used mortars made by a mixture of calcium hydroxide, sand, and sometimes an additive of vegetable extract.

Fig. 2. Mayapan's Mayan murals (Source: Martínez, 2021)

One of the most used extracts is the *chucum* (*Harvadia Albicans*). *Chucum* is a legume plant with a small leaf, which has thick "V" spines at its base (González et. al, 2019)

Fig. 3. Chucum tree *(Harvadia Albicans)* (Source: Martínez, 2021)

There are records of the use of chucum extract in documents since the sixteenth century, noteworthy that the primary sources in these times were the master builders who resided in the communities surrounding archaeological sites. These documents were a watershed for the development of multiple investigations oriented to the technique of Mayan mortars. As a result of the Spanish conquest, there was a mixture of knowledge applying local materials and techniques for the construction of new buildings. Such was the case of the application of mortars with chucum extract in haciendas, urban dwellings, and other buildings generated from the sixteenth century in irrigation channels and water tanks as wells and cisterns. With the fall of the haciendas' agroindustrial production, the use and application of mortar were partially forgotten. It only remained in the memory of the inhabitants, whose knowledge was transmitted from past generations. The rescue of the technique is given thanks to archaeologists and restorers who, together with the preserved knowledge of the communities, have managed to determine some of the components used in the mortars. In the last decades, mortars with chucum are mainly produced in a semi-industrialized way, resulting in the creation of a "Chukum base" that is a product composed mainly of fine powder and white cement. This product is widely distributed throughout Mexico and begins to make its way internationally.

Víctor Toledo *et al*. developed an ethnoecology method described as the K-C-P complex, which consists of the set of beliefs or *kosmos* (k), the repertoire of knowledge or *corpus* (c), and the productive activities or *praxis* (p) (Toledo et al., 2018, pp. 3, 4), through the address of biocultural heritage and the understanding of the interaction of man-nature, practices, knowledge, and culture of traditional groups, indigenous, local peoples and peasants. The aim of this study was to characterize as biocultural heritage by the K-C-P method the mortars with chucum (Harvadia Albicans) in Yucatán, Mexico.

2. Methodology and tools

For the research presented in this paper the ethnographic tool of Participant Observation (OP) was taken as a basis (Vasilachis, 2006) in order to identify changes and permanence in the use of lime traditional mortars. As a first approach, face-to-face and digital surveys were carried out with people related to construction (masons,

architects, engineers, merchants). Through the exploratory study based on the "snowball" technique (Polsky, 1969, in Taylor & Bogdan, 1994) a total of 169 responses were obtained.

A later field study was conducted in Nunkiní, Dzitbalché and Hechelchakán in the state of Campeche, and Tipikal, Halachó, Motul and Espita in the state of Yucatán. The inclusion criteria for interviewed people used were: belonging to communities in the Yucatan Peninsula, which are recognized for their work in their locality, having inherited the knowledge of their father or teacher, and accessing the interview through an informed consent format. The interviews were conducted in an open or semi-directed manner so that the interviewee did not limit his information. At the same time, the "in-depth interview" process was developed (Taylor & Bogdan 1994). In this way, data were collected that make up the three aspects of the k-c-p complex described in ethnoecology.

3. Results

3.1. Kosmos (beliefs and traditions)

The system of beliefs and traditions rooted in construction techniques in the use of chucum in traditional mortars is mainly linked to the management of plant species. For the form of transmission of knowledge and scenarios, the classification that separates the "vertical form" (VT) of knowledge transmission, that is, from grandfather, father to child, and by "horizontal transmission" (HT), which means that those involved are not related, was considered (Miss-Domínguez et al., 2017). Based on the information collected in the surveys, of the 80 people who have knowledge of the technique of making mortars with chucum,14% had a VT and in the other 86% the HT. This fact denotes that the main scenario of transmission and learning of the technique is at building work. On the other hand, the transmission of knowledge of what chucum is is also presented. It was obtained that 16% of the 169 respondents knew the chucum on VT. It should be noted that along with the answer they always mention the learning space, in this case, the "mountain" or the crop field. The other 84% obtained it by HT and the learning space that predominated was building work. In the case of knowledge of how to make the chucum extract; of the eight interviewees, six had a VT. Only two of them were learned by a HT. The reasons that lead to the interest in learning reflect the importance for the interviewees of the cultural heritage of their ancestors, their beliefs around their application, and their relationship with their traditional practices. Two were found mainly causes, the first is the motivation for the perpetuation of the family legacy and the second is merely economic. The whole process of making the mortar carries a cultural burden only because of the folkloric denomination of the tree, the rocks, and the preparation of the lime, among other aspects.

The majority of respondents (75%) and interviewees are unaware of the existence of other types of chucum. However, a few (11% of respondents) reported two; one red called *chucumchak* or *chakchucum,* and one white, which they call *sakchucum.* These varieties of *chucum* are also reported in the Yucatan Encyclopedia of 1977. Like trees, rocks and soils receive a folkloric denomination depending on their morphology, their uses, or their relationship with ritual aspects. For example, Shreiner (2003) explained that the folkloric name of the lime-making process refers to birth. In the case of lime making, several articles have been published and research has been carried out that has shown the persistence of certain types of rituals. Among them, the placement of vessels, some prayers of thanksgiving, and the placement of crosses arranged in a specific way stand out. It is also mentioned the orientation of the lime kiln and some beliefs such as avoiding the presence of women during calcination (Magaloni, 1996, 1998; Schreiner, 2003; Russell & Dahlin, 2007). All the interviewees agreed that they were not familiar with the association of their practice with any type of ritual process in the technique of making mortars or the elaboration of lime.

3.2. Corpus (knowledge and awareness)

The practices involve a grouping of knowledge that occurs under the maintenance of learning scenarios. As seen in the previous section, this information is transmitted generationally. In the case of the technique of mortars with chucum, it was necessary to divide the knowledge into the three main components, the extract or additive, the cementant and the sand. The results of the survey regarding the general question of 'what is the chucum?' were very varied, but two groups were assembled. Of the 169 surveys, 111 people relate to chucum as part of nature (tree, bush, tree resin, among others). The other group belongs to those who consider it a product (mortar, finish, material).

3.2.1. Vegetable additive (chucum)

All the people interviewed and 66% of the respondents, confirmed knowing about the chucum tree and distinguishing it between the different species that make up its natural environment. In addition to recognizing it, they attribute different uses, in construction, as firewood and in the tannery. The qualities of these additives are provided by tannins which are water-soluble substances that are present in the bark, leaves, roots and fruits of plants and trees of different species. The astringent property of tannins causes the skins to stabilize and in this way their putrefaction is prevented (Jáidar, 2006; Larqué-Saavedra, 2016).

The chucum is a tree up to 20m high with short spines and bipinnate leaves; it has a 10-12 mm sheath and a flat, thin fruit 10 cm long. In general, the population that is most in contact with the natural environment recognizes the tree by its thorns and by its thin leaves. Another feature they mentioned is that it contains bitterness, this was checked by testing the torn bark. The feeling of bitterness is due to the astringent substances characteristic of tannins.

Fig. 4. Chucum tree's thorns and leaves (Source: Martínez)

The *chucum* tree is distributed throughout the Yucatan Peninsula (Flores 2001, Duno 2014) and in large quantities. Duno (2014) in his research, concludes that the species is outside any category of threat with an abundant population throughout the peninsula and a low risk of extinction. The response of the interviewees shows that there is a high availability of the species. The result of the surveys (40% mention that it is very easy to find the tree) confirms raised by Duno (2014). This indicates that people do not have to travel long distances to find it. It was found that none of the interviewees is limited to cutting it at any time of the year; however, three of them mentioned that, if cut in the dry season, even though it is a little more difficult to extract, the bark contains more astringent substance. On the contrary, in the rainy season, it is easier to obtain the bark, but they mentioned that rain dilutes the astringent substance in the trunk. After deep research in the literature, no bibliographical information was found about the concentration that the extract may have in a certain season of the year.

3.2.2. Cementant

Within the research appeared two types of cementants mainly. One is lime and caters to the traditional technique and the other is white cement, used by current generations of builders.

The use of lime has declined as the main cementitious material in construction. This is demonstrated by the results obtained from the questionnaires, from people who say they know the process, only 20% affirm the use of lime in traditional mortars with chucum.

Regarding the knowledge of the elaboration of baking lime or traditional lime, the interviewees reiterated that it is an activity that is no longer practiced and they attribute it to "the ancients", referring to the people belonging to the Mayan community who have already passed away.

The main information regarding the cementants is that of the recognition of the rocks or geology. One of the interviewees mentioned two types of rocks, the one that is used for the elaboration of lime called *sak eel b'aach.* This stone has a similar origin to a type of sandy soil that is very abundant in the Yucatan peninsula that is known regionally by the name of *sascab*. In the same sense, another of the interviewees indicated that the stone used is "sascabosa" (like-sascab).

Among the characteristics mentioned by the interviewees to identify the *sak eel b'aach*, are weight, sound and resistance. These rocks must be light, this is one of the first features to identify. With the help of a hammer or machete (cutting tool), they determine the hardness or strength of the rock. They make cuts or fissures to the rock to check its resistance and generate a sound to know its hardness.

3.2.3. Sand

Sand, as well as lime, has been replaced by other more available materials. Of the 80 people who know the process of making the mortar, only 13% use *sascab* in the mixture.

The main knowledge related to the aggregate component is to know how to identify soils. The name of the soil depends on its morphological characteristic. In this case, the *sascab, sajkab' or sajka'* means white earth, white rock. Some characterize it depending on its particle size or mechanical behavior as sandy or silty soil with a low presence of clay (Pacheco & Alonzo, 2003; González & Vega, 2002). For his part, Littmann (1958) mentions that this material is mainly made up of calcite and is the product of weathering and erosion of the limestone material.

The Mayan master builders have been able to identify the types of *sascab* to assign it a certain use. For example, one of the interviewees commented that the *sascab* he gets from his cave contains a substance he calls *k'aab* [1] or *k'at* [2] and that it has a sticky, yellow consistency. He commented that when he made his mortars, the amount of lime he used was minimal.

3.3. Praxis (traditional practices)

Productive practices are the materialization of knowledge and beliefs. In this case, the practices related to the elaboration of the extract, the lime and the mixture are explored.

3.3.1. Preparation of the extract (times, quality controls)

Interviewees look for logs with larger diameters. When it is dry season, it is necessary to hit the trunk to be able to extract the bark since it does not contain water that favors the process. In the rainy season, it is not necessary, only a small cut is made with a machete (cutting tool) and removed in the direction parallel to the branch.

Interviewees who are related to the practice of crop, the harvest of the bark is done by pruning and the whole tree is not used. This ensures that it can regenerate and continue to grow. Jáidar (2006) mentions that it is necessary to be careful with the way to detach it so as not to affect the species and then let it rest for at least two years for its recovery.

The bark is arranged depending on the type of extraction. For "sancocho"[3] it is necessary to cut into strips 20 to 50 cm long. On the contrary, for maceration at room temperature very small pieces are available.

[1] It means broth, liquid or juice (Bastarrachea & Canto, 2007, p. 110)
[2] It means mud, clay or mud. Very fine soil that has the property of acquiring a sticky consistency when wet (Bastarrachea & Canto, 2007, p. 110)

[3] Sancocho is the term mostly used for the process of hot maceration of the bark in water.

Fig. 5. Two ways to cut the bark (Source: Martínez, 2021)

The two main forms of extraction found are that of maceration at room temperature linked mainly to bibliographic sources on restoration issues (Morris 1931; Littmann, 1960; Magaloni, 1996; Jáidar, 2006; García and Jáidar, 2013; Santini, 2005; Lorenzo, 2019). and heat maceration, "sancocho" or boiled is more related to contemporary constructors the case of extraction through maceration, the bark is placed directly in the water after turning it into small fibers. The sancocho consists of placing the strips of bark in a metal container and heating.

Fig. 6. Extraction techniques: maceration at room temperature and sancocho respectively (Source: Martínez, 2021)

In studies conducted by various sources (Morris 1931; Littmann, 1960; Magaloni, 1996; Jáidar, 2006; García and Jáidar, 2013; Santini, 2005; Lorenzo, 2019), the extraction method used consisted of letting stand in water for no more than two days, that is, a maceration. There is a wide variation in the times of obtaining the extract. The type of extraction does not influence the times considered. On the part of the surveys, no answers were presented on the maceration times at room temperature, but as with the interviewees, the times in the sancocho varied greatly. The times were grouped into less than five hours, between five and 24 hours, and those that take more than 24 hours. The most frequent time was 5 to 24 hours with 38%. The main indicator to demonstrate that the extraction is being done correctly is the color, as mentioned by one of the interviewees. The extract at the end of the process should have shades between purple and black. Contrary to this information, García and Jáidar (2013) warns that the "color intensity of these solutions is not a reliable parameter to measure the degree of saturation" (García & Jáidar, 2013, p. 120).

3.3.2. Preparation of lime

Lime processing is a chemical transformation of limestone rock. Researchers from several areas have hypothesized how the Mayan culture made traditional lime. American archaeologist Earl H. Morris recounts a technique known as "rotting". He mentions that lime was made using kilns, where the limestone rock was burned and then left outdoors to receive moisture from rain or dew (Morris, 1931). Two of the interviewees recounted the process they have used and coincided with what was described by archaeologist Earl H. Morris. Both mention that it is "rotten". One of the interviewees described the construction of the lime kiln as a square shape, very similar to type four mentioned by Thoma Schreiner (2001). Another interviewee described the lime tree as a round shape, as shown by Morris (1931). Mayan lime kilns, square or round have the main characteristic of using green firewood or logs with a high humidity level. This makes it have great thermal insulation and in this way, the calcination is slower and more controlled.

3.3.3. Preparation of the mixture

How the mortar is prepared varies within the literature on how they assume it was prepared in pre-Hispanic times, among restorers and how it is currently used in contemporary constructions. Most sources based on restoration and archeology refer to what was described by Morris (1931). Who mentioned that the mix consisted of 3 parts sascab to 1 part lime. After that, several studies were carried out varying the moments in which the vegetable additive was added (Magaloni, 1996; Jáidar, 2006; García and Jáidar, 2013;

Santini, 2005; Lorenzo, 2019). The components in the traditional mortars have been replaced. In the information obtained by the interviewees, the use of white cement has spread throughout the builders taking it as the original mixture. All interviewees agree that the amount of extract depends on the final finish desired by the customer and the manageability of the mixture to be applied. They look for a texture that they describe as "like cake mix". About the surveys, it was obtained that of the people who know how to apply mortar, 25% have used products already industrialized or that sell preparations. However, as stated in previous paragraphs, they prefer the technique they know as "traditional". The main properties found through interviews and surveys were aesthetic, economical, durability, protection, fungicides and impermeability. In the survey it was asked what qualities the extract provided to the mortar, the most frequent response was for aesthetic issues derived from the color and smooth texture.

One of the results obtained by Jáidar (2006) in his study was that chucum increased the physicochemical properties of the mixtures with which he experimented. The bulk density was improved and its permeability to water vapor, porosity and absorption by capillarity decreased. On the part of Magaloni (1996), the properties she found were that it helps to avoid cracking of the mortar at the time of drying since they retain moisture (hygroscopic) and delay and improve the setting, giving it waterproof or water-resistant properties. (Magaloni, 1996, p. 53). As mentioned in the introduction the use of mortar has been modified over time changing the purpose for which it is applied. Initially, the use of chucum extract was required to provide strength and manageability properties to mortars. Also as mentioned in the properties described by the restorers and archaeologists were used for the protection of buildings against extreme agents due to the climate of the region. With colonization, the purpose of the use of these mortars did not change and was used in pools and drinkers of cattle, as well as in exterior coatings. Finally, mortars are currently used for restoration, but mainly for finishes in swimming pools but their use has already covered any surface that requires a coating either interior or exterior, and is or is not in contact with moisture or water.

4. Conclusions

Based on the results, the intersection of the three aspects of the productive practices of the indigenous peoples is appreciated. It was demonstrated through the analysis of the variables and their evaluation from the k-c-p complex, that traditional mortars with *chucum* have sufficient aspects that make it possible to consider them as a biocultural heritage. It emphasizes the great role played by restorers and archaeologists in the documentary conservation of the process of making mortars but that without the presence of memory and the conservation of learning scenarios by the original peoples they would not have been able to achieve the task. Therefore, addressing issues of cultural heritage is necessary from a holistic perspective and with the active presence of indigenous peoples, through the dialogue of knowledge. Despite the gradual abandonment of the technique, it would be important to consider its reappropriation by the Mayan community, since it could provide a solution to problems of habitability within their homes that, unlike the solutions implemented by the government, will adapt in a better way and ancient wisdom would be rescued. It is possible to consider that the wisdom of indigenous peoples that has a sense of conservation and respect for nature rooted can provide solutions to prevent practices from dragging these environmental problems. It is necessary to dialogue knowledge between teachers from Mayan communities and industry, and in this way share knowledge related to sustainable management methods of the species, such as harvest seasons and extraction techniques. This process may broaden the interest in rethinking the study carried out by the Center for Scientific Research of Yucatan to define if it is a species that does not

run the risk of extinction considering the market and the current demand for the extract. It is hoped that the present study will contribute to the enhancement of traditional forms of linkage between societies and their environment, as a measure to mitigate ecological damage that is becoming increasingly critical, as well as socio-cultural damage resulting from the loss of cultural diversity.

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