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JANILO ITALO MELO DANTAS

MUTAÇÃO E TRAÇOS BIOCULTURAIS MAL ADAPTADOS EM SISTEMAS MÉDICOS LOCAIS

RECIFE-PE
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Tese apresentada ao Programa de Pós-Graduação em Etnobiologia e Conservação da Natureza (UFRPE, UFPE, UPE e UEPB), como parte dos requisitos para obtenção do título de Doutor em Etnobiologia e Conservação da Natureza.

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DEDICATÓRIA

Dedico aos meus avós- Benício Melo e Izabel Melo (in memoriam) e aos meus pais- João Dantas e Iranilda Brandão que nunca mediram esforços para me apoiarem nos meus sonhos e objetivos.

“Eu sou apenas um rapaz latino-americano
Sem dinheiro no banco, sem parentes importantes
E vindo do interior”

“Mas trago de cabeça uma canção do rádio
Em que um antigo compositor baiano me dizia
Tudo é divino, tudo é maravilhoso”

(Belchior)

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SUMÁRIO

Dantas, Janilo Italo Melo. Universidade Federal Rural de Pernambuco. Maio de 2024. **Mutação e traços bioculturais mal adaptados em sistemas médicos locais.** Elcida de Lima Araújo, Ulysses Paulino de Albuquerque, André Luiz Borba do Nascimento.

RESUMO

Apesar da transmissão cultural ser um processo importante para os sistemas socioecológicos como os sistemas médicos locais, de acordo com o campo teórico da Evolução Cultural (EC), as informações que são transmitidas são passíveis a alterações. Essas alterações podem ser aleatórias (Mutação Cultural) e também intencionais (Variações Guiadas). A ocorrência de mutações culturais podem desempenhar implicações para as pessoas. Um exemplo disso, é o estabelecimento de "Traços Bioculturais Mal Adaptados" (Comportamentos adotados que não desempenham benefícios para a sobrevivência dos indivíduos). Nos sistemas médicos locais, esses traços podem ser exemplificados pelas plantas medicinais que não possuem a eficiência desejada. Apesar de existirem evidências sobre mutações e traços bioculturais mal adaptados, muitas das evidências na evolução cultural tratam-se de estudos teóricos e matemáticos. Além disso, os fatores envolvidos no estabelecimento desses processos no cenário de populações humanas, ainda são obscuros. Nesta tese, buscamos investigar quais fatores contribuem para um maior/menor estabelecimento de mutações e de traços bioculturais mal adaptados em sistemas médicos locais. Para isso, investigamos ás seguintes questões: 1) como diferentes modos de transmissão cultural operam sob o estabelecimento de mutações culturais em sistemas médicos locais?; 2) como a versatilidade de uso e o compartilhamento de informações sobre plantas medicinais contribuem para a ocorrência de mutações culturais?; III) como o viés de prestígio influencia na ocorrência de mutações culturais e de variações guiadas? E IV) qual a relação da ocorrência de mutações culturais com o estabelecimento de traços bioculturais mal adaptados em sistemas médicos locais?. Para investigar essas questões, estudamos o sistema médico local da comunidade Lagoa do Junco no município de Santana do Ipanema, Alagoas, região Nordeste do Brasil. Para investigar a ocorrência de mutações culturais, realizamos entrevistas semiestruturadas com 120 indivíduos maiores de 18 anos da comunidade. Para verificar os traços bioculturais mal adaptados, realizamos uma revisão bibliográfica da literatura farmacológica para classificar tratamentos eficientes e ineficientes a partir das informações sobre plantas medicinais. Para as análises usamos modelo linear generalizado (GLM), regressão logística e teste de Wilcoxon-Mann-Whitney através do software R. Também utilizamos uma regressão linear simples através do software BioEstat. Nossos dados indicaram que modos de transmissão cultural mais conservativos são menos propensos a mutações culturais. Também descobrimos que informações sobre plantas medicinais versáteis e informações sobre plantas medicinais mais compartilhadas são mais propensas a mutações culturais. Além disso, evidenciamos que o viés de prestígio desempenha um papel fundamental no conhecimento sobre plantas medicinais e que é um fator que influencia de maneira direta no estabelecimento de mutações culturais e de variações guiadas em sistemas médicos locais. Além do mais, também descobrimos que plantas medicinais com mutações culturais não geram uma maior quantidade de traços bioculturais mal adaptados em sistemas médicos locais. Esperamos que nossos resultados forneçam maiores esclarecimentos sobre mutações e traços mal adaptados em populações humanas e que aumentem as compreensões sobre o funcionamento e evolução dos sistemas médicos locais.

Palavras-chave: Etnobiologia Evolutiva; Etnobotânica; Evolução Cultural; Plantas Medicinais

Dantas, Janilo Italo Melo. Universidade Federal Rural de Pernambuco. Maio de 2024. **Mutation and maladapted biocultural traits in local medical systems.** Elcida de Lima Araújo, Ulysses Paulino de Albuquerque, André Luiz Borba do Nascimento.

ABSTRACT

Although cultural transmission is an important process for socio-ecological systems such as local medical systems, according to the theoretical field of Cultural Evolution (CE), the information that is transmitted is subject to change. These changes can be random (Cultural Mutation) and also intentional (Guided Variations). The occurrence of cultural mutations can have implications for people. An example of this is the establishment of "Badly Adapted Biocultural Traits" (Adopted Behaviors that have no benefits for the survival of individuals). In local medical systems, these traits can be exemplified by medicinal plants that do not have the desired efficiency. Although there is evidence about mutations and maladapted biocultural traits, much of the evidence in cultural evolution is theoretical and mathematical studies. Furthermore, the factors involved in the establishment of these processes in the setting of human populations are still unclear. In this thesis, we seek to investigate which factors contribute to a greater/lesser establishment of mutations and maladapted biocultural traits in local medical systems. To this end, we investigated the following questions: 1) how do different modes of cultural transmission operate under the establishment of cultural mutations in local medical systems? 2) how does the versatility of use and sharing of information about medicinal plants contribute to the occurrence of cultural mutations?; III) how does prestige bias influence the occurrence of cultural mutations and guided variations? And IV) what is the relationship between the occurrence of cultural mutations and the establishment of poorly adapted biocultural traits in local medical systems? To investigate these questions, we studied the local medical system in the Lagoa do Junco community in the municipality of Santana do Ipanema, Alagoas, Northeast region of Brazil. To investigate the occurrence of cultural mutations, we carried out semi-structured interviews with 120 individuals over 18 years of age from the community. To verify maladapted biocultural traits, we carried out a bibliographical review of the pharmacological literature to classify efficient and inefficient treatments based on information on medicinal plants. For the analyzes we used a generalized linear model (GLM), logistic regression and the Wilcoxon-Mann-Whitney test using the R software. We also used a simple linear regression using the BioEstat software. Our data indicated that more conservative modes of cultural transmission are less prone to cultural mutations. We also found that versatile medicinal plant information and more shared medicinal plant information are more prone to cultural mutations. Furthermore, we demonstrate that prestige bias plays a fundamental role in knowledge about medicinal plants and that it is a factor that directly influences the establishment of cultural mutations and guided variations in local medical systems. Furthermore, we also found medicinal plants with cultural mutations do not generate a greater amount of maladapted biocultural traits in local medical systems. We hope that our results provide further insights into mutations and maladaptive traits in human populations and that they increase understandings about the functioning and evolution of local medical systems.

Keywords: Evolutionary Ethnobiology; Ethnobotany; Cultural Evolution; Medicinal plants

1. INTRODUÇÃO GERAL

1.1. OBJETIVOS E QUESTIONAMENTOS

Os sistemas médicos locais podem ser considerados como um dos principais sistemas socioecológicos (Albuquerque *et al*., 2020) e foram desenvolvidos pelos seres humanos a partir da existência de doenças e pelas estratégias que as pessoas passaram a utilizar para curar os problemas de saúde (Dunn, 1976). Uma prática comum dos sistemas médicos locais é a transmissão de informações culturais. Por sua vez, as informações que circulam nesses sistemas são denominadas pelo campo da Etnobiologia Evolutiva (EE) como "Traços Bioculturais" (Albuquerque *et al*., 2020).

Um exemplo de traços bioculturais nos sistemas médicos locais seriam as informações sobre as práticas do uso de plantas medicinais (Santoro et al.,2018). Essa prática consiste em uma das principais estratégias adotadas pelos indivíduos para curar determinadas enfermidades (Santoro *et al*., 2020; Molares & Ladio, 2014; Medeiros *et al*., 2017) e ocorre através da dinâmica de transmissão cultural (Brito *et al*., 2019; Soldati & Albuquerque, 2016). Dessa forma, fica evidente que a transmissão de traços bioculturais desempenham um papel fundamental para a dinâmica dos sistemas médicos locais. Porém, apesar de sua importância, de acordo com a "Teoria da Evolução Cultural" (EC), as informaões que são transmitidas no contexto das culturas humanas são passíveis a erros de cópia não intencionais (Mesoudi, 2011), promovendo a ocorrência de mutações culturais. Em adição, os erros de cópia da informação podem também ocorrer de forma intencionalmente, processo denominado de denominado de "Variação Guiada" (Mesoudi,2011).

A ocorrência de mutações culturais (erros de cópias não intencionais) podem ter implicaçãoes para as populações humanas. Um exemplo seria o estabelecimento de "Traços Culturais Mal Adaptados" (comportamentos adotados que não desempenham nenhum benefício para a sobrevivência dos indivíduos) (Baravalle, 2012; Mesoudi, 2011), os quais na Etnobiologia Evolutiva (EE), sção denominados como "Traços Bioculturais Mal Adaptados (Albuquerque *et al*., 2020). Nos sistemas médicos locais, tais traços podem ser representados por plantas utilizadas para fins medicinais que não possuem a eficiência farmacológica desejada (Dantas *et al*. 2020; Santoro *et al*., 2018; Tanaka *et al*. 2009). Embora existam outras formas de avaliar a eficiencia de cura como a psicológica, a exemplo do efeito placebo (Dias & Sartori, 2015), espiritual (Ferreira *et al*. 2021) e religiosa (Oliveira, 2018), neste estudo adotamos a eficiência farmacológica das plantas medicinais como proxy porquê as propriedades químicas e farmacológicas de plantas medicinais vêm sendo considerado como um dos fatores mais importantes para a efetivação de cura de enfermidades humanas. Além disso, a eficiência farmacológica de plantas medicinais tem sido a

mais documentada por trabalhos acadêmicos, permitindo dessa forma, uma maior aproximação para avaliar a presença de traços bioculturais mal adaptados.

Atualmente, apesar de existirem evidências associadas a mutações e a traços mal adaptados na evolução cultural, poucos foram desenvolvidas com populações humanas, considerando seus sistemas médicos (Mesoudi, 2011; Santoro *et al*., 2020). Assim, no presente estudo objetivanos investigar os fatores que podem contribuir para um maior ou menor estabelecimento de mutações culturais e de traços bioculturais adaptados em sistemas médicos locais.

Para alcançar o objetivo da tese, inicialmente nós buscamos testar como diferentes modos de tranasmissão cultural poderiam influenciar no estabelecimento de mutações culturais. De acordo com o campo téorioco da evolução cultural, a transmissão de informações culturais pode ocorrer de diferentes formas, sejam elas; de pais para filhos (via vertical), entre indivíduos da mesma geração sem relação parental (via horizontal) e entre indivíduos de gerações distintas, que não possuam relação parental (via oblíqua) (Mesoudi, 2011). Alguns estudos desenvolvidos através de modelos teóricos e matemáticos, evidenciaram que a transmissão de informações por via vertical, por ser restringir apenas de pais para filhos, pode funcionar como uma rota mais conservadora das informações e ser menos sujeita a variação nas informações, contribuindo para menores taxas de mudanças ao longo do tempo (Hewlett & Cavalli-Sforza, 1986). Em contrapartida, a aprendizagem por via horizontal e via oblíqua podem contribuir para uma maior variedade de informações para os indivíduos de um sistema, promovendo maiores taxas de mudanças ao longo do tempo (Cavalli-Sforza & Feldman, 1981). Porém, os estudos existentes consideram a premissa do marco teórico da evolução cultural mas nunca foram testadas no cenário de populações humanas reais. Dessa forma, nós neste estudo buscamos testar á seguinte hipótese: H1: *modos de transmissão mais conservativos são menos propensos à ocorrência de mutação cultural*. Nossa expectativa é de que a via vertical apresente uma menor frequência de traços com mutação em comparação com as vias oblíqua e horizontal.

Em adição, a frequencia de transmissão de determinada informação nos sistemas culturais vem sendo sugerida como um fator que aumentar as chances de sua modificação (De Barra *et al*., 2014; Santoro *et al*., 2018) e isto nos levou propor testar á seguinte hipótese: H2: *o compartilhamento do conhecimento sobre uma planta medicinal influencia na ocorrência de mutações culturais em sistemas médicos locais*. Nossa expectativa é de que traços bioculturais mais compartilhados apresentem maior frequência de mutações.

A versatilidade de uso das plantas tem sido questionada como um outro fator indutor de mutações culturais, pois uma planta versátil reúne um conteúdo amplo e variado de informações (Acerbi & Tennie, 2016; Dantas *et al*., 2020; Caetano *et al*., 2020). Logo, durante o processo de

transmissão cultural, as informações sobre as espécies versáteis podem ser mais difíceis de serem memorizadas, aumentando as chances de ocorrerem mutações culturais. Além disso, as informações sobre essas plantas podem está levando a um "Desencontro Causal" (Henrich & Mcelreath, 2003), pois devido a versatilidade medicinal pode está havendo uma falta de entendimento na mente dos indivíduos sobre qual a real função/funções das plantas medicinais. Considerando que versatilidade de usos pode tem implicações na transmissão das informações intentamos avaliar a seguinte á seguinte hipótese: *H3: informações sobre plantas medicinais versáteis são passíveis de maior mutação cultural em sistemas médicos locais.* Nossa expectativa é de que traços bioculturais que apresentem maior versatilidade de usos medicinais apresentem maior frequência de mutações.

O prestígio social do informante é um outro fator que talvez possa influenciar a transmissão de informações, sendo esse fenômeno considerado como um "Viés de Prestígio" (Berl *et al.*, 2021; Henrich & Gil-White, 2001). Alguns estudos na evolução cultural registram que os indivíduos considerado como modelo de Prestígio social são pessoas com conhecimento/habilidade acima da média no contexto em que estão inseridos (Henrich & Gil-White, 2001; Jimenéz & Mesoudi, 2020), existindo evidências de que informações de pessoas com prestígio podem ser melhor transmitidas (Jiménez & Mesoudi, 2021) e mais propensas de serem memoráveis do que informações de fontes não prestigiadas (Oliveira *et al.*, 2023). Considerando a influência do Prestígio social, nós buscamos testar ás seguintes hipóteses: H4: *indivíduos prestigiados possuem mais conhecimento sobre plantas medicinais que aqueles menos prestigiados*. Nossa expectativa é de que haverá uma maior proporção de informações sobre plantas medicinais para pessoas de prestígio do que para outras fontes de transmissão. H5: *informações sobre plantas medicinais oriundas de fontes prestigiadas são menos propensas a mutações culturais do que as provenientes de fontes menos prestigiadas*. Esperamos que a frequência de traços culturais com mutação seja menor quando obtidos por pessoas de prestígio do que por outras fontes de transmissão.

É ainda possível que o elevado conhecimento das pessoas de pestígio os leve a alterar as informações de forma intencional, favorecendo ao surgimento de variação guiada (Jiménez & Mesoudi, 2019; Henrich & Gil-White, 2001). Considendo que elevada expertise do informante pode contribui para ocorrência de variação guiada, testamos ainda á seguinte hipótese: H6: *indivíduos prestigiados promovem mais variação guiada do que mutação cultural.* Nossa expectativa é de que a taxa de informações alteradas pelas pessoas de prestígio seja maior para variação guiada do que para mutação cultural.

Por fim, admitindo que mutações culturais podem contribuir para o estabelecimento de traços mal adaptados (Mesoudi, 2011), testamos á seguinte hipótese: H7: *informações sobre plantas medicinais com mutações culturais geram uma maior quantidade de traços bioculturais mal*

adaptados do que as informações de plantas que não apresentam mutações. Nossa expectativa é de que haverá maior proporção de traços bioculturais mal adaptados em informações que sofreram mutação do que em informações que não sofreram.

Esperamos que a realização desta tese possibilite escopos mais amplos e permita maiores esclarecimentos sobre a ocorrência dos processos de mutação cultural e traços mal adaptados no cenário de populações humanas, especificamente nos sistemas médicos locais.

1.2. ESTRATÉGIAS DE PESQUISA

A coleta de dados associados a mutações culturais foi feita utilizando-se métodos bastantes frequentes em estudos etnobiológicos (Albuquerque *et al.*, 2014; Dantas et al., 2020). Por exemplo, para investigar o conhecimento local sobre plantas medicinais, foi utilizada a técnica de "Listagem Livre" (Albuquerque *et al*., 2014), consistindo em convidar os informantes a listar o nome de todas as plantas conhecidas por eles que possuíam alguma finalidade medicinal. Após essa lista, foram realizadas "Entrevistas Semiestruturadas" (Albuquerque *et al*., 2014). Por sua vez, a realização das entrevistas possibilitaram verificar tanto o conhecimento local sobre plantas medicinais, assim como, possibilitou a identificação de indivíduos transmissores (pessoa que transmitiu a informação/informações) e de indivíduos aprendizes (pessoa que aprendeu a informação/informações) no sistema médico local. Após as entrevistas semistruturadas, as informações a respeito de uma mesma planta que fosse utilizada pelos indivíduos aprendizes e indivíduos transmissores foram analisadas e comparadas, o que possibilitou a identificação de mutações culturais. Com isso, consideramos mutação quando: o alvo terapêutico (doença), indicado por um indivíduo aprendiz, foi diferente do indicado pelo indivíduo transmissor da informação e quando a parte da planta utilizada pelo aprendiz foi diferente do indivíduo transmissor da informação.

Para os dados relacionados a traços bioculturais mal adaptados, além das informações sobre mutações culturais coletadas, realizamos uma revisão bibliográfica da literatura farmacológica. Essa revisão teve como objetivo realizar uma busca por trabalhos que tivessem realizado testes farmacológicos com as plantas que foram citadas pelos informantes da comunidade. A busca pelos trabalhos, foi realizada a partir do nome científico da espécie de planta citada durante as entrevistas, acompanhada de suas possíveis atividades farmacológicas esperadas. Essa busca foi feita em periódicos que possuíam trabalhos relacionados na área medicinal e farmacológica. Através disso, classificamos os tratamentos eficientes e ineficientes de acordo com o ponto de vista farmacológico. Para auxiliar na classificação das informações como tratamentos ineficientes/eficientes, as mesmas foram separadas por unidades de informação. Unidades de informação (UI), se refere a associação

entre uma planta + doença ou agravo que a determinada planta é indicada + parte da planta utilizada para a cura da doença ou agravo indicado (Santoro *et al*., 2015). Por exemplo, "Aloe vera (L.) Burm. F.– dor de cabeça- folha", "Mentha villosa Huds. – gripe- folha", "Psidium guajava L.– são exemplos de três unidades de informação distintas entre si. A partir da revisão dos estudos farmacológicos, consideraremos como um tratamento ineficiente/traço biocultural mal adaptado, as unidades de informações de plantas medicinais que não apresentaram a atividade farmacológica esperada.

1.3 ESTRUTURA DA TESE

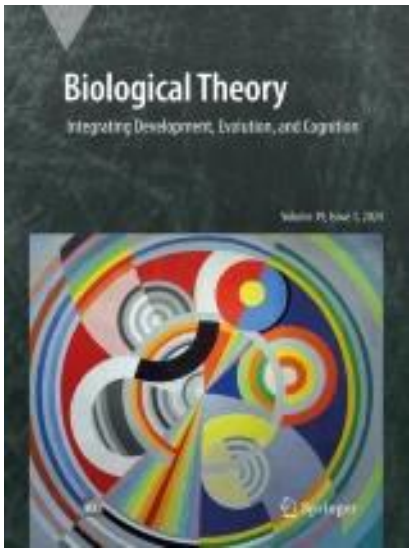
A presente tese está dividida em cinco capítulos. No primeiro capítulo abrangemos a fundamentação teórica, na qual, buscamos reunir através da literatura evidências teóricas e explicativas sobre o estabelecimento de mutações culturais e suas implicações enquanto um dos principais processos microevolucionários da evolução cultural. Com isso, elaboramos um manuscrito intitulado como: *"What do we know about cultural mutation in cultural evolution? A brief review".* O segundo, terceiro e quarto capítulo tratam-se de estudos de caso que buscaram responder nossas perguntas de pesquisa. Especificamente no segundo capítulo, nós buscamos investigar quais fatores contribuem para um maior/menor estabelecimento de mutações culturais em sistemas médicos locais. Esse manuscrito encontra-se intititulado como: *"Investigating the dynamics of cultural mutations in local medicinal plant use in NE BRAZIL"*. No terceiro capítulo, nós buscamos investigar a influência do viés de prestígio na dinâmica da evolução cultural nos sistemas médicos locais e encontra-se intitulado como: "*The Influence of Prestige Bias on Knowledge and the Dynamics of Cultural Transmission about Medicinal Plants in Local Medical Systems"*. No quarto capítulo, nós buscamos investigar quais fatores estão associados ao estabelecimento de traços bioculturais mal adaptados em sistemas médicos locais. Esse manuscrito encontra-se intitulado como: "*A influência de mutações culturais no estabelecimento de traços bioculturais mal adaptados em sistemas médicos locais"*. Por fim, no quinto e último capítulo, nós trazemos as considerações finais da tese, na qual descrevemos as principais conclusões e as contribuições dos nossos estudos. Além disso, nós descrevemos as limitações encontradas na realização dos nossos estudos e sugerimos algumas possibilidades de trabalhos futuros.

CAPÍTULO I - Fundamentação Teórica

WHAT DO WE KNOW ABOUT CULTURAL MUTATION IN CULTURAL EVOLUTION? A BRIEF REVIEW

(Artigo submetido na revista Biological Theory)

Link para as normas da revista: (https://link.springer.com/journal/13752/submission-guidelines)



What do We Know About Cultural Mutation in Cultural Evolution? A Brief Review

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Abstract

The Theory of Cultural Evolution (CE) is one of the theoretical fields that seeks to explain how culture evolves. Among some EC assumptions, the different microevolutionary processes that can promote changes and affect the dynamics of cultural traits in human populations stand out. Thus, these processes are critical and need to be investigated since they can contribute to the understanding and advances in the field of cultural evolution. Here, we gather evidence associated with cultural mutations, constituting an important microevolutionary cultural evolution process. Moreover, the implications of cultural mutations for the fitness of different human cultures are discussed, information from certain related works is highlighted, and research gaps are pointed out. We also discuss how cultural mutations are important to investigate in the context of social-ecological systems, such as local medical systems. We hope that the evidence presented will clarify cultural mutations and inform new contributions and discussions of the theoretical assumptions of cultural evolution.

Keywords: Culture. Information transmission. Copy errors. Cultural evolution

Introduction

The theory of cultural evolution (EC) provides tools and a theoretical arsenal to understand the variables that can affect the diffusion of cultural information and predict how cultural information behaves over time (Mesoudi, 2011). For EC, culture tends to evolve (Mesoudi, 2011). This evolution of culture can be explained similarly to biological evolution according to Darwinian studies, considering aspects of variation, competition, and heredity (Mesoudi, 2011). For example, just as species vary in an environment and compete with each other to survive and perpetuate themselves, cultural information may vary and, in this case, tend to compete, even if only indirectly (e.g., competition for expression or attention in the environment), because some traits are more likely to spread within a cultural or environmental context than others are), and those that are more likely to be learned, that is, more adopted in the behavior of individuals, become socially inherited (Mesoudi, 2018; Santoro et al., 2018).

In this sense, it is evident that the transmission of cultural information between individuals in a population is a dynamic process and a determining factor for the variation, adaptation, and evolution of human behavior (Baravalle, 2012; Barkow, 1989). However, people do not always acquire information or imitate behaviors reliably, as the transmission of cultural information is subject to copying errors, termed “Cultural Mutations” in EC (Barkow, 1989).

The occurrence of cultural mutations is one of the main microevolutionary processes in cultural evolution (Mesoudi, 2011). The occurrence of cultural mutations causes variation in cultural traits (information). This variation is essential for cultural evolution (Mesoudi, 2011). Establishing cultural mutations can generate positive, neutral, or negative effects that can affect the dynamics of information in certain human populations in the medium- to long term. An example of this is the establishment of “Maladapted Cultural Traits,” in which adopted behaviors do not contribute to the fitness of individuals (Barkow et al., 1989; Mesoudi, 2011).

Thus, investigating the occurrence of cultural mutations is essential to understand how practices, knowledge, beliefs, and consequently the evolution of different human cultures can be affected by this form of information change and to understand factors favoring their appearance (Richerson & Boyd, 2005). This paper presents brief theoretical evidence and explanations regarding the establishment of cultural mutations, one of the main processes of cultural evolution.

Cultural Mutations

According to Mesoudi (2011), similar to genetic mutation, cultural mutations result from transmitting unreliable information. In this process, ideas/information change randomly as they are transmitted from one person to another. Cultural mutations can result from failures associated with human memory and the influence of cultural factors and can generate variations in cultural traits that are socially inherited (Eerkens, 2000).

Cultural mutations can be explained similarly to the transmission of genetic information (Richerson & Boyd, 2005). The transmission of genetic inheritance between parents and children can be altered by errors that occur in genes. Similarly, cultural information can be altered and disseminated due to errors between individuals (Baravalle, 2012; Richerson & Boyd, 2005). Errors in genetic transmission and copying of cultural information can have implications for human cultures. However, errors in transmitting cultural information cause diversification (i.e., variability in information), which is a necessary factor for cultural evolution (Baravalle, 2012).

The game Chinese whispers (Utami & Rahmawati, 2018) is a good instance of how cultural mutations occur. In

this game, the players form a line or circle. The first player whispers a message into the ear of the second person. That person whispers the message to the next person, continuing from person to person. Finally, the last participant announces the message he/she received. This message is compared with the first message (Utami & Rahmawati, 2018). The changes in the message that can occur during the course of transmission can be comparable to the occurrence of cultural mutations in cultural evolution.

Additionally, the transmission of cultural information associated with the production of objects and materials can exemplify the occurrence of cultural mutations. Kempe et al. (2012) used artifacts (hand axes) as an example. The authors explained that when copying information related to hand axes, individuals tend to copy certain information inaccurately, consequently leading to the manufacture of materials with various artifacts.

In the context of local medical systems, cultural mutations can be exemplified through changes in cultural traits associated with medicinal plants. For example, someone can transmit information about using plant X to cure headaches to another person. The individual who receives the information can assimilate that plant X cures flu and not headaches, as suggested by the information (Dantas et al., 2020). This is because cultural information is not copied identically between individuals, as it can be reconstructed differently in each person's mind (Laland & Brown, 2011). O'Brien et al. (2016) wrote that when cultural traits are transmitted, "they serve as units of replication, insofar as they can be modified as part of a cultural repertoire, through processes of loss or alteration" of information.

It is worth noting that people can change information through guided varia'Ion (Mesoudi, 2011). This proces' differs from cultural mutations. Guided variation is a process in which culturally transmitted information is intentionally altered (Mesoudi, 2011). For example, one person may transmit the information to another, and the bark of plant X is used to cure headaches. However, individuals who receive the information intentionally and preferentially can use the leaves of plant X and not the bark, as suggested in the information, to cure headaches, either because the leaf has a better flavor or greater efficiency than the bark or for other reasons (Dantas et al., 2020). By doing so, the individual intentionally alters the information that was received.

Consequently, this modified information can be transmitted to other people. Another example of guided variation can also be seen in the study by Santoro et al. (2018). For example, someone learns about a species of palm tree used to make a specific object. However, then an environmental variation makes that species of palm tree unavailable at a certain time. This unavailability may cause the individual to use the original information received (i.e., the shape of the palm leaves) to experiment with a similar species. In this way, the initial information that a plant X can be used to make the object can be modified intentionally, which results in adding a new plant to the repertoire. Therefore, when comparing guided variation and cultural mutations, guided variation also promotes cultural diversification, but it occurs because individuals intentionally modify information to achieve a certain objective, causing certain information to become better adjusted for the individual (Mesoudi, 2011).

Thus, from an evolutionary point of view, cultural mutations and guided variations are microevolutionary processes that promote cultural evolution (Mesoudi, 2011). However, only some case studies on this process have been published despite the role of guided variation in cultural evolution. Furthermore, studies in cultural evolution have shown that cultural mutations, being an unconscious process, play a significant role in cultural variations and have been highlighted as processes with a high likelihood of contributing to the establishment of maladaptive cultural behaviors (processes that will be briefly discussed) (Dantas et al., 2020; Pereira et al., 20218; Santoro et al., 201; Mesoudi, 2011). Meanwhile, guided variations, despite their implications, being conscious, are less likely to generate maladaptive traits from a cultural perspective. Consequently, this paper focuses on the published factors that generate cultural mutations. A

view of the implications of cultural change based on existing explanations is presented.

Factors Causing/Influencing the Emergence of Cultural Mutations

Arkes (1991) and Barkow (1989) pointed out two factors that may favor altering cultural information. The first is the incomplete transmission of information, when only part of complex or varied information can be transmitted or assimilated in the minds of individuals. For instance, in human populations, it is common to share information with large or varied content that can be transmitted or assimilated into individuals' minds. An example of this type of information would be the details about plant complexes, which are common in local medical systems (Dantas et al., 2020). Plant complexes are mixtures of plants in which various medicinal species are combined, along with alcoholic or sweetened substances, forming a compound used to cure or alleviate certain ailments (Camargo et al., 2010; Dantas et al., 2020; Pereira et al., 2020). These preparations are produced through the exchange of cultural information among individuals. In turn, due to the wide variety of plants and other substances that make up these preparations, the information conveyed about these preparations carries a substantial volume of details, which can contribute to the emergence of cultural mutations (Dantas et al., 2020).

In turn, these cultural traits increase the chances of people transmitting certain information inaccurately because of the vast amount of information that needs remembering. In other words, it is much information all at once, which can lead to confusion and the occurrence of mistakes. The second factor is confusion concerning the information. When assimilating different information, the minds of individuals can transmit probable information instead of adequate information. For example, it is common for people to receive information about versatile medicinal plants (plants used to treat different diseases) in local medical systems. Thus, from the moment a plant is indicated to cure several diseases, there may be a lack of understanding of the real functions of a certain plant species, increasing the chances of information being transmitted with errors of judgment to other people (Arkes, 1991).

Another factor that can cause cultural mutations is the number of times certain information is transmitted (i.e., when a person "A" tells information to a person "B" and this person transmits it to a person "C"). This is because when a certain characteristic is transmitted several times, the probability of an error increases. The more time people transmit information to others, the more susceptible this information will be too random changes (Mesoudi, 2011; Santoro et al., 2018). Mutations promoted by the number of times or the frequency with which the information is transmitted are like the modification of information that occurs in the aforementioned Chinese Whispers game (Santoro et al., 2018), since as the Information is transmitted, it can be reconstructed in each person's mind (Laland & Brown, 2011).

As cultural mutations result from a process fully associated with cultural transmission, how people learn from each other is another important factor in understanding the establishment of cultural mutations and the pace of cultural evolution. For example, some mathematical models have shown that in social information systems in which the vertical transmission of information (from parents to children) predominates, the acceptance of innovations becomes less favorable and can function as a more conservative strategy for cultural information, causing cultural evolution to occur more slowly than other transmission routes (Cavalli-Sforza & Feldman, 1981; Hewlett & Cavalli-Sforza, 1986; Reyes-Garcia et al., 2009). Thus, theoretical evidence suggests that vertical transmission conserves information because transmission from parents to children only results in the accumulation of changes from one generation to another (Santoro et al., 2018).

However, in systems where horizontal transmission between unrelated members of the same generation and

oblique transmission between unrelated individuals of different generations are predominant, the acceptance of innovation in information becomes more favorable, leading to higher rates of change over time (Hewlett & Cavalli-Sforza, 1986; Soldati & Albuquerque, 2016). Additionally, it is possible that social learning through horizontal and oblique pathways promotes greater variety and obtaining information (Boyd et al., 2011). However, these are also conducive to the emergence of cultural mutations. These pathways allow the transmission of traits between all individuals of the same or different generations (Mesoudi, 2011).

An important factor to be mentioned is that there are some biases that can act on the dynamics of cultural transmission (Mesoudi, 2011; Boyd & Richerson, 1985) and that can influence the occurrence of cultural mutations. Examples of these biases would be "Conformity Bias" and "Model Bias".

The conformity bias occur when individuals prefer to copy information based on behaviors most people use in the social system. An example would be an individual using a particular plant or natural resource to treat a health issue because other people also use it. Conformity bias leads people to believe that the majority shares information without verifying it. Therefore, copying information adopted by the majority allows people to learn what to do without understanding why it is done (Abbott & Sherratt, 2011). Consequently, the chances of information being obtained through copying errors increase.

Model bias occurs when people copy information from individuals with great knowledge or a certain cultural context. For example, the model can be selected based on the experience, expertise, gender, age, and other factors. An example of model bias would be the "Prestige" based model (Henrich & Gil-White, 2001). When people prefer to copy information based on "Prestige Bias", in which others perceive individuals as being experts or having deep knowledge of certain subjects, there can be a potential decrease in the error of copying the information (Reyes-García et al., 2008). For Henrich and Gil-White (2001) and Soares et al. (2023), information provided by prestigious individuals can be more transmitted and memorable in some situations compared to information from non-prestigious individuals. This is because prestigious people can be seen as experts, intelligent, or possessing extensive knowledge of the subject compared to other people, leading individuals to accept their information more than those without prestige (Santoro et al., 2018). For example, Holtgraves et al. (1989) performed three experiments to examine the effects of information from prestigious and non-prestigious people on individuals' memorization. The results demonstrated that participants remembered information related to prestigious people better than non-prestigious people. Often, this can occur because individuals may perceive an advantage in information provided by prestigious people compared to information provided by non-prestigious people.

Implications of Occurrence of Cultural Mutations

Generally, when cultural information is inherited through mutations, the harm or advantage resulting from the modification may not be perceived by individuals (Santoro et al., 2018). However, once information is changed, it can generate negative, positive, or neutral effects in different human populations (Barkow, 1989).

Positive Implications of Cultural Mutations

Stout et al. (2002) provided an example of how the occurrence of copying errors can be culturally important. Their findings in ethnographic research and analysis associated with the manufacture of stone tools produced from social

learning in a local population in Indonesia showed that the error of copying information became important in the generation of variety in the models of the tools produced by individuals and that this information contributed to technological innovation associated with the tools. This technological innovation of tools can be exemplified, for example, by the new forms of materials and new uses of tools concerning environmental changes; the occurrence of information copy errors may be more important for individuals than a reliable copy of cultural information (Truskanov & Prat, 2018). The authors used mathematical models to demonstrate that 22ynthesize22ing errors in information, cultures can more easily adjust to a changing environment because of the variety of information developed by copying errors. In other words, within a scenario of environmental changes, copying errors increase the possibility of information or behavior being more adjusted to the new environmental conditions. However, although copying errors are relevant in certain scenarios (Stout et al., 2002; Truskanov & Prat, 2018), this process can also increase the chances of establishing "ill-adapted cultural traits," as discussed below.

Negative Implications of Cultural Mutations

The negative effects of cultural mutations can be exemplified by the establishment of "Maladapted Cultural Traits" (Mesoudi, 2018). Maladapted cultural traits are evidenced as behaviors adopted by individuals that do not contribute to their adaptation to a busy environment and may even lessen the efficiency of a particular human practice (Richerson & Boyd, 2005). However, these traits continue to propagate in local human populations. Information copying errors can be widely transmitted and become permanent in the short- or long-term, depending on the environmental scenario in which a given human population is inserted (Barkow, 1989; Tanaka et al., 2009).

Maladapted cultural traits can be exemplified by, for instance, using industrialized drugs to treat specific diseases without demonstrating the expected pharmacological validation (De Barra et al., 2017; Macfarlane et al., 2020). An example of this is the use of hydroxychloroquine in Brazil and other countries to treat the COVID-19 pandemic without proven efficiency (Menezes et al., 2020). One of the factors that supposedly contributed to its use was the prior use of chloroquine for other types of viral diseases (see Menezes et al., 2020). This experience led some people to develop associations between drug use and COVID-19. Another factor that contributed to the adoption of this behavior was social incentives. This is because even though hydroxychloroquine is ineffective for COVID-19, the current president of Brazil and other politicians recommended its use for states and municipalities without supporting evidence. Thus, many believed in this information and consequently adhered to the behavior.

In the scenario of local medical systems, Santoro et al. (2018) and Dantas et al. (2020) described that some maladaptive cultural behaviors can be exemplified through the use of traditional remedies, such as the medicinal use of plants, even if the plants often do not have the desired medicinal benefit. This is because, in local medical systems, disseminated treatments are only sometimes efficient (Tanaka et al., 2009). In the case of medicinal plants, some of these treatments may not be used for curative purposes because of the occurrence of cultural mutations. For example, Dantas et al. (2020) and Pereira et al. (2021) explained a possible way in which the occurrence of cultural mutations can lead to the establishment of maladapted cultural traits, considering local knowledge about medicinal plants. According to these authors, one person can transmit information to another, and plant X is used to cure headaches. However, to use an example cited earlier, an individual who receives the information may instead understand that plant X serves to cure flu and not to cure headaches. Thus, the individual who erroneously learned the information randomly altered the information

concerning the plant's medicinal function. This erroneous alteration can cause a particular plant to be used ineffectively in treating certain diseases, constituting a poorly adapted cultural trait.

Other examples of maladapted cultural traits are smoking and cannibalism. Despite causing various diseases and reducing their survival, various human cultures have culturally disseminated these behaviors (Mesoudi, 2011). Moreover, the existence of food taboos may represent maladaptive cultural traits. For example, in some local populations, there is a belief that the simultaneous consumption of mango and milk can cause illness or death (Meireles et al., 2019). This cultural trait was intentionally disseminated at the time of slavery to prevent enslaved individuals from consuming mangoes and milk, which were expensive and important foods at that time (Vieira, 2010).

Neutral Implications of Cultural Mutations

Although studies on cultural evolution only show the positive and negative effects of cultural mutations, neutral effects may also exist. The neutral effects of cultural mutations can be characterized as those that maintain fitness. An example of these effects is using some alternative medicines that are not efficient in curing diseases but do not cause direct or indirect harm (see Blanco et al., 2014).

When information about medicinal plants is transmitted with copy errors, the medicinal species to be used may not perform the expected medicinal function but may not be harmful without collateral damage. As with medicinal plants, this can also occur through other cultural practices, whether using industrialized medicines and through transmitting knowledge about objects/materials.

Factors that Contribute to the Permanence of Cultural Mutations and Maladaptive Cultural Traits

Many cultural mutations that emerged have been maintained and disseminated through social learning. If cultural mutations can have serious implications, including being harmful to human adaptation, why do many of these tend to be preserved in the cultural context of human populations?

Arkes (1991) and Barkow (1989) espoused that a factor that favors the permanence of copying errors is the credibility given to the person who transmits the information (Abbott & Sherratt, 2011). This is because individuals generally trust the information they receive from others. Therefore, cultural trust is one of the justifications for explaining the permanence of cultural mutations (De Barra et al., 2014) since cultural information is often considered reliable and beneficial (De Barra et al., 2014).

Another factor that justifies the permanence of cultural mutations is that individuals quickly copy cultural strategies. Thus, owing to the transmission speed, not all information obtained has been verified before adoption (Henrich, 2009). In addition, the human brain has evolved imitatively, implying that people can acquire information without verifying its real adaptive value (Baravalle, 2012). In this way, when acquiring certain information, humans accept it and transmit it to others in the social system.

For authors such as Santoro et al. (2018), eliminating some cultural mutations will only occur if the information error jeopardizes the fitness of individuals in a given population. For example, Okeke et al. (2006) investigated traditional healers' perceptions of malaria's causes, symptoms, and treatment in southeast Nigeria. The authors found that most individuals with malaria did not go to health facilities to seek treatment for the disease because they believed the information related to the effectiveness of their herbal remedies. Moreover, those who sought health care only went after a few days of using traditional treatments, which resulted in long delays in receiving adequate treatment, with implications

for the population's health status.

Durham (1991) presented a brief discussion of the “Cannibalism of Fore” (Papua New Guinea Highland Group, who had a cultural tradition of feeding on deceased relatives as an act of faith and solidarity). According to the author, this practice over time led to the emergence of the disease of kuru (popularly known as Mad Cow Disease), which forced an end to this tradition. Thus, even though Fore Cannibalism is a bad adaptation, this cultural behavior was maintained for some time until the arrival of the disease, as it represented a common belief (Antonello, 2015). Thus, poorly adapted cultural traits can often persist because they are part of a broad and well-established cultural practice. Although a specific cultural trait is ill-adapted, it remains linked to other elements that are culturally important to a given population (Baravalle, 2012).

Some researchers have attempted to understand the establishment of ill-adapted cultural traits in situations linked to treating diseases (i.e., in the employment and promotion of inefficient treatments in medical systems). For example, De Barra et al. (2014) showed that two factors can explain the permanence of poorly adapted traits in different human populations. The first is cultural trust in a treatment. Certain cultural practices generally transmitted between people are considered reliable and beneficial. The second is that information about effective treatments is more likely to spread than information about ineffective treatments, as people generally share successes more than failures. This can occur both in using treatments in human populations and in disseminating information from the medical literature (De Barra et al., 2017).

According to Tanaka et al. (2009), the persistence of maladaptive cultural traits in human populations critically depends on the rates of recovery from disease and cases of treatment abandonment. Therefore, even if a treatment is ineffective, if many people perceive that recovery is good and few of them discontinue the treatment, it will continue to be strongly disseminated. Related to what Tanaka et al. (2009) and Ioannididis (2017) described, it inferred that the permanence of maladaptive cultural traits is influenced by evidence-based rumors, such as the information people convey about their experiences with certain medications. Even if there are ineffective treatments, if many people disseminate evidence/information that such treatments are effective, they tend to be constantly used by people because of the successful transmission of information. From this perspective, it can be inferred that the permanence of ill-adapted cultural traits is related to cultural conformity, in which individuals follow behaviors adopted by most people in a population (Logan & Qirko, 1996).

According to other authors, such as Blanco and Matute (2020), another factor contributing to the permanence of maladapted cultural traits is people’s overestimation or illusory belief about the effectiveness of completely inefficient treatments. The authors used self-limiting diseases as an example. Self-limiting diseases like the flu or headache typically resolve spontaneously without treatment or intervention. However, even with this spontaneous resolution, the use of certain drugs that can alleviate these maladies can spawn an illusory belief that this is only possible because of the effectiveness of such drugs. The illusory belief discussed by Blanco and Matute (2020) had been previously considered by Hartman (2009), who inferred that many ineffective treatments seem useful because the signs and symptoms associated with diseases commonly improve when initiating any specific treatment. However, improvement of symptoms is often not always related to the treatment used. Other factors, such as the placebo effect (Moerman, 2002), can create the belief that the treatment improves the disease when the treatment does not include a medicinal compound. Therefore, regardless of a drug’s direct, effective, and therapeutic effect, individuals often feel better and end up adhering to such treatments.

Another contributing factor to the persistence of maladapted traits is ineffective treatment’s lack of side effects (Blanco et al., 2014). When people use certain drugs and do not notice any unpleasant effects, the frequency of their use

tends to increase. Other authors, such as Macfarlane et al. (2020), argue that one of the factors that can lead to the maintenance of ineffective treatments is fraudulent health claims. By disseminating false information about drugs, these claims can strongly contribute to the continued use of drugs that may be harmful.

Studies Related to Cultural Mutations

Recent studies with evolutionary cultural approaches highlight that different social learning processes may be involved in cultural mutations. Table 1 summarizes the main findings.

Kempe et al. (2012) provided important theoretical information and evidence for a new experimental test of cultural mutation applied to archeology based on the Accumulated Copy Error (ACE) model proposed by EerKens and Lipo (2005). The ACE model suggests that individuals try to copy exactly the size of another individual's artifact but make small random errors due to physiological limits related to their perceptions. Based on studies of psychophysics (a scientific discipline of psychology that studies the relationship between physical stimuli and perceptual responses), human perception has physiological limits, especially in the ability to perceive differences between objects. In turn, this can favor random errors, such as cultural mutations. Kempe et al. (2012) performed an experimental test associated with the ACE model using transmission chains with 200 participating individuals to explain morphological changes of artifacts (hand axes). The results were as predicted by the model, as there was a variation in the size of the artifacts produced by the individuals who tried to copy the information on the size of hand axes from other participants. Thus, the existence of physiological limits related to the perception of individuals, as proposed by the ACE model, is important to consider in studies related to cultural mutation in archeology and other studies related to cultural evolution.

In addition to the study described above, other studies on copying errors related to archeology and related areas have generated important evidence for understanding the occurrence of cultural mutations. For example, Eerkens (2000) pointed out that the time information stored in human memory can significantly influence the occurrence of copying errors, which in turn can affect the production and variation of artifactual objects. Through experiments such as visual perception, the author sought to assess whether people's memory and motor skills contributed to the variation in artifacts. In the experiment, the author identified that the variation in artifacts decreased when individuals had access to information shortly before the experiment and increased when individuals depended on memory to remember information from a distant past. The findings show that the time people acquire and store information can determine the emergence of copying errors, such as cultural mutations. In this sense, the evidence presented by Eerkens (2000) is a good suggestion for studies related to cultural mutations in human populations, considering the influence of the time that individuals acquire certain cultural information.

Additionally, Schillinger et al. (2016) attempted to experimentally address the issues of copying errors (mutations) with the phylogenetic relationship of artifact traditions. The authors evaluated how different mutation rates would affect the evolutionary processes of artifacts from experimental transmission chains, where individuals copied artifacts from other participants. Phylogenetic relationships were suggested to be more accurate in artifact lineages when mutation rates are lower, as well as evidence that the fidelity of information transmission directly influences the evolution of artifact technological traditions.

Acerbi and Tennie (2016) evaluated the frequency and size of cultural traits transmitted between people and showed that these aspects can also significantly influence information fidelity. The authors investigated how copying

redundant information could influence the fidelity of cultural transmission. They considered redundant information, such as the possibility of individuals repeatedly copying the same trait over time or the ability of multiple variations associated with the same cultural trait. The findings indicated that redundant information could increase the probability of fidelity in cultural transmission. This further suggests that copying redundant information can effectively achieve fidelity and preserve cultural traits transmitted to human populations. In local medical systems, this term can refer to information that is extensive and has varied content.

Another example would be information about plant complexes or vegetable mixtures, such as bottles, syrups, and licks (Dantas et al., 2020). These preparations are produced from a combination of different medicinal plants and various specific substances. Thus, due to the great variety of plants and substances necessary to produce plant complexes during cultural transmission, the information about these preparations is extensive and has a varied content.

Other authors, such as Schillinger et al. (2015), investigated the relationship between imitative *versus* emulatory learning and the occurrence of information copy errors associated with the production of artifacts. The authors considered "Imitation" as a direct copy of the observed actions of a model individual (e.g., observation of the information and techniques used by a given individual to produce an artifact) and "Emulation" as an indirect copy of the observed actions of an individual model (e.g., observation of only the information and not of techniques that led to the production of artifacts). Copying error rates were statistically higher when individuals adopted emulated behaviors and significantly lower when they adopted imitated behaviors. These findings indicate that the more details people assimilate from information from a model individual, the lower their chances of copying errors. Adopting behaviors by imitation may be important to reduce the rates of cultural mutations compared to other types of social learning in cultural transmission, such as emulation.

Schillinger et al. (2017) experimentally evaluated information copy errors between individuals, using the manufacture of additive materials (with greater variations, e.g., ceramics) *versus* reductive materials (smaller variations, e.g., kneading stones) as the study model. Error rates of copying information/mutation were higher for materials with smaller variations than for materials with greater variations. Based on these findings, it is possible to show that copying errors are potentially random, regardless of the size of the information and content. The authors suggested that the factors contributing to this process are important and should be investigated in future studies to clarify the evolution of material culture.

Studies with human groups in controlled situations have been performed to assess how copying errors appear and are transmitted. For example, Xu et al. (2013) performed a laboratory simulation of cultural evolution, examining how the role of cognitive biases that influenced cultural transmission could influence color naming by humans. By simulating the process of cultural transmission in the laboratory, the authors showed that cognitive biases caused by cultural transmission influenced individuals' naming of color nomenclatures. The findings suggest that it is important to consider the influence of cognitive biases in studies related to cultural mutations or other studies associated with cultural transmission.

Other scholars, such as Eerkens and Lipo (2005), sought to systematically examine how the processes of cultural transmission (with error copies) amplify, reduce, or maintain the variation of archaeological ceramic materials over time. Distributions in the variation of archaeological materials from simulations caused by small errors that people transmitted through cultural traits were demonstrated. The findings indicate that the occurrence of copying errors is one of the main contributors to the cultural variation of materials generated over time. This variation is mainly perceived through the production of artifacts with different characteristics, including size and thickness.

Shillinger et al. (2014) studied 90 subjects to systematically test how time variations (minutes) could affect copy error rates in transmitting artifact information. The average copying error levels increased when the production time of artifacts was reduced. This result indicates that it is important for studies related to cultural mutations to consider the time of information acquisition as a variable among the variables to be studied in experiments, as time can be a potential influence in the determination of cultural mutation rates (Eerkens, 2000).

An important factor to mention is that when analyzing the studies found, it is clear that most of them focus on cultural traits related to artifacts. This demonstrates the importance of carrying out studies that investigate the occurrence of cultural mutations, considering other types of cultural traits.

Table 1. Summary of the Main Findings of Studies on Cultural Mutations

Authors/work	Situation studied	Main findings
Kempe et al. (2012) and Eerkens and Lipo (2005)	Accumulated Copy Error (ACE) model. Influence of random copying errors on morphological changes of artifacts (hand axes).	Human perception has physiological limits, especially the ability to perceive differences between objects. This can favor random errors, such as cultural mutations, generating changes in the production of artifacts.
Eerkens (2000)	Influence of visual perception, memory, and motor skills on variation of artifacts.	The time in which information is stored in human memory can significantly influence the occurrence of copying errors, which in turn can affect the production and variation of artifactual objects.
Schillinger et al. (2017)	Influence of information copying errors on the manufacturing of additive versus reductive artifacts	Information copying/mutation error rates are higher for materials that have smaller variations than for materials that have greater variations.
Schillinger et al. (2015)	Imitative *versus* emulative learning in the occurrence of errors in copying information associated with the production of artifacts	The more details people assimilate from information from a model individual, the lower the chances of copying errors. Imitation becomes important to reduce the rates of cultural mutations sufficiently.
Shillinger et al. (2014)	Influence of time variations (minutes) on copy error rates on the transmission of artifact information	Average levels of copy error increase when artifact production time is reduced.
Acerbi and Tennie (2016)	Influence of copying redundant information on the fidelity of cultural transmission	The frequency and size of cultural traits that are transmitted between people can significantly influence the fidelity of information.

Local Medical Systems as an Object of Studies of Cultural Mutations

In general, a local medical system can be understood as a social process in humans based on the perceptions that these individuals assimilate about diseases and the strategies that are used to cure them (Lewens, 2018; Dunn, 1976).

Local medical systems are complex, with meanings and norms related to social aspects (Dunn, 1976; Kleinman, 1978). Researchers, such as Kleinman (1978), have highlighted local medical systems in their studies as cultural systems because culture can shape social aspects and the gradual changes that these systems undergo. A striking feature of these systems is the transmission of cultural information, as many of the strategies linked to the promotion of health and disease by people are developed through social learning (Dunn, 1976; Lewens, 2018). Additionally, these systems are influenced by different ways of transmitting knowledge, which in turn implies the heterogeneity of different cultural information, causing information to be inherited by cultural mutations. Thus, understanding the dynamics of transmission and acquisition of cultural information between individuals, or how this information is acquired and incorporated into human populations, such as by the occurrence of cultural mutations, is crucial for understanding cultural evolution (Gallois et al., 2018).

Recent studies have used local medical systems as a study model to understand the occurrence of cultural mutations. For example, Dantas et al. (2020) sought to empirically understand the relationship between the accumulation of cultural mutations and the knowledge associated with the use of plant complexes and isolated medicinal plants in local medical systems. The mutation rate was higher when plants were used alone than when plant complexes were used. The mutation rate was also higher for information associated with the medicinal functions of plant species than for the parts of the plants used. Additionally, no relationship was evident between plants perceived as more or less efficient in local medical systems, and information changes occurred more randomly (cultural mutations) than intentionally (guided variation). The results highlight the occurrence of cultural mutations in local medical systems and indicate that the transmission of knowledge about medicinal plants can be one of the main factors that contribute to the accumulation of these processes in human populations.

Pereira et al. (2021) investigated the influence of socioeconomic variables that included gender, age, and education on the occurrence of cultural mutations in local medical systems. Age and education influenced the occurrence of cultural mutations in local medical systems; mutations were more frequent in younger individuals and individuals with higher education. Additionally, gender did not influence the occurrence of cultural mutations in local medical systems, indicating that the knowledge of men and women showed a similar number of cultural mutations. These findings suggest that older individuals with a lower level of formal education have more reliable sources of knowledge about medicinal plants in local medical systems. In the case of older people, experimentation and greater life experience associated with medicinal plants can make them remember certain information more reliably. Additionally, people with less education may have more contact with or make more frequent use of medicinal plants compared to people with more education, which leads to fewer errors.

Dantas et al. (2024) sought to understand which factors could be associated with the dynamics of cultural mutations in local medical systems based on knowledge of medicinal plants. The authors showed that more conservative modes of transmission (vertical transmission) are less prone to cultural mutation. The authors also showed that information associated with versatile medicinal plants (plants used to treat different diseases) generates more cultural mutations than information from non-versatile plants and that information from plants that are more shared is more likely to generate cultural mutations.

Despite the existence of studies related to cultural mutations in medical systems, understanding these processes requires further scientific investigation. Santoro et al. (2018) suggested the following questions for studies necessary to advance the understanding of cultural evolution, some related to cultural mutations: 1) how do different transmission routes generate changes in knowledge and (2) how does the perception of a particular resource or cultural trait affect the copying of information?

In addition to the suggestions of Santoro et al. (2018), further investigations are crucial for enhancing our understanding of the occurrence of cultural mutations in local medical systems. Questions pivotal to these investigations include:

• 1) What factors contribute to a greater/lesser establishment of cultural mutations and guided variation in human populations? Investigating these factors would shed light on what causes the human mind to transmit information with more or fewer errors. Are they, for instance, pieces of information with a larger volume? Are they less/more socially transmitted? Or are they about resources less frequently used by people in local medical systems?

• 2) Is the occurrence of cultural mutations less frequent for cultural traits associated with model biases than for those associated with other types of biases? Do more conservative modes of transmission result in fewer cultural mutations? Studies directed at this question can help understand how people's perceptions of others influence the occurrence of cultural mutations. In this context of model bias, it is important to consider that there are already a number of studies indicating that prestige bias has implications for cultural transmission (Jiménez & Mesoudi, 2020; Henrich & Broesch, 2011; Berl et al., 2021; Henrich & Gil-White, 2001; Oliveira et al., 2023 among others). However, it is still necessary to direct efforts toward the development of studies that investigate the influence of prestige bias on the dynamics of cultural evolution in local medical systems. For example, are the pieces of information transmitted by individuals with high local status memorized more effectively, hence transmitted with fewer errors? Do prestigious individuals promote less cultural mutation in local medical systems? Moreover, do prestigious individuals promote greater guided variation in local medical systems?

• 3) Can the size of the human population influence the occurrence of cultural mutation?

In general, the literature has discussed the role of population density in cultural evolution (Shennan, 2001; Vaesen, 2012; Strassberg & Creanza, 2021; Henrich, 2017; Derex & Mesoudi, 2020 among others). Some authors, such as Strassberg and Creanza (2021), mention, for example, that the cultural factors present in human populations can vary according to the size of the population. The larger the population size, the greater the diversity of differences. According to Henrich (2017), the size of the population can reduce or produce a complete loss of the use of some cultural practices. This indicates the importance of developing studies that investigate the influence of demographic factors on the establishment of cultural mutations in local medical systems.

Research on this topic can elucidate how population size can accelerate evolutionary changes in certain human cultures. For example, does a larger population size lead to a higher number of cultural mutations? Conversely, does a smaller population size lead to fewer cultural mutations? Can demographic changes in a population influence the occurrence of cultural mutations?

• 4) Are cultural mutations more or less frequent than guided variations? This line of investigation can help discern which processes have caused the most cultural variations in human populations. For example, do cultural mutations lead to more significant changes in the cultural evolution of human populations than guided variation?

• 5) Are cultural mutations influenced by how long the information has been known by the individual learner? This can help us understand how the duration of information stored in human memory impacts the occurrence of cultural mutations. For instance, does newly acquired information that's soon transmitted to another person lead to fewer cultural mutations?

• 6) Does repeated copying of cultural traits produce more transmission fidelity? Studies with this focus can shed light on how the frequency of specific information affects the occurrence of cultural mutations. For instance, are frequently transmitted pieces of information better memorized and thus less prone to mutation?

• 7) Can cultural traits associated with a single transmission route yield higher transmission fidelity than those acquired through different routes? Research here can elucidate how using different transmission routes can influence the occurrence of errors in human populations.

• 8) What are the impacts of cultural mutations on the human-resource relationship? This investigation can clarify the effects of cultural mutations on human cultures. For instance, have cultural mutations impacted human cultures' survival? Do pieces of information with higher mutation rates lead to a higher occurrence of ill-adapted cultural behaviors?

• 9) Do the methods employed to assess cultural mutations and guided variations in human populations need refining? Research in this direction can illuminate the precision and efficiency of methodologies that studies on cultural mutations have employed. For example, are there biases in the methodologies used to gather data on cultural mutations in human populations?

An important factor to mention is that the investigation of the occurrence of cultural mutations can also be approached using the perspective of other ideas in the field of cultural evolution. An example of this would be the idea of "Subjective Cultural Selection" (Singh, 2022). According to this idea, people evaluate behaviors and beliefs based on their efficiency in achieving certain goals (Singh, 2002). Thus, in cultural contexts, many cultural practices evolve because they satisfy people's goals and motivations (Singh, 2002). Thus, considering the idea of subjective cultural selection and its implications for cultural mutations, we suggest some questions for future studies: Do the cultural practices that people perceive as more efficient provide fewer cultural mutations? Does information from medicinal plants perceived by people as more important/efficient promote less cultural mutation in local medical systems? Plant information perceived by people as less important/efficient promotes more cultural mutations in local medical systems.

Studies of these questions within and between different ethnicities and in different non-traditional populations will effectively increase our understanding of the processes of cultural mutations in human populations and enhance or adjust the theoretical assumptions of cultural evolution.

Conclusions

Cultural traits (information) that undergo modifications when transmitted between people (copying errors) allow cultural evolution, as shown in Figure 1 (below). Such modifications may occur intentionally, resulting in guided variations. They may also occur randomly, resulting in cultural mutations. Although changes in information are relevant for cultural evolution to occur, their establishment can have positive effects (contributing to people's fitness) and negative effects (representing maladaptive cultural traits) and may affect human cultures on short, medium, or long time scales, and may be neutral (e.g., maintaining fitness).

Studies related to cultural mutations are more frequent than those related to guided variation because the probability of cultural mutations generating maladaptive cultural traits is greater than the modifications generated by guided variation. This also remains to be studied. In addition, studies on cultural mutations have been performed based on mathematical models, laboratory studies (memorization experiments), and some case studies in real human populations. However, most studies of cultural mutations have involved archaeology. There are relatively few ethnobiology studies associated with local medical systems.

To advance the discussion on cultural evolution, it is important to perform studies to fill the gaps in knowledge in human populations. Considering the complexity that can exist in the context of each location, studying the occurrence of cultural mutations in human populations, such as social-ecological systems, can be challenging, but is extremely important to advance the understanding of cultural evolution and for the proposal and adjustments of biocultural conservation management measures.

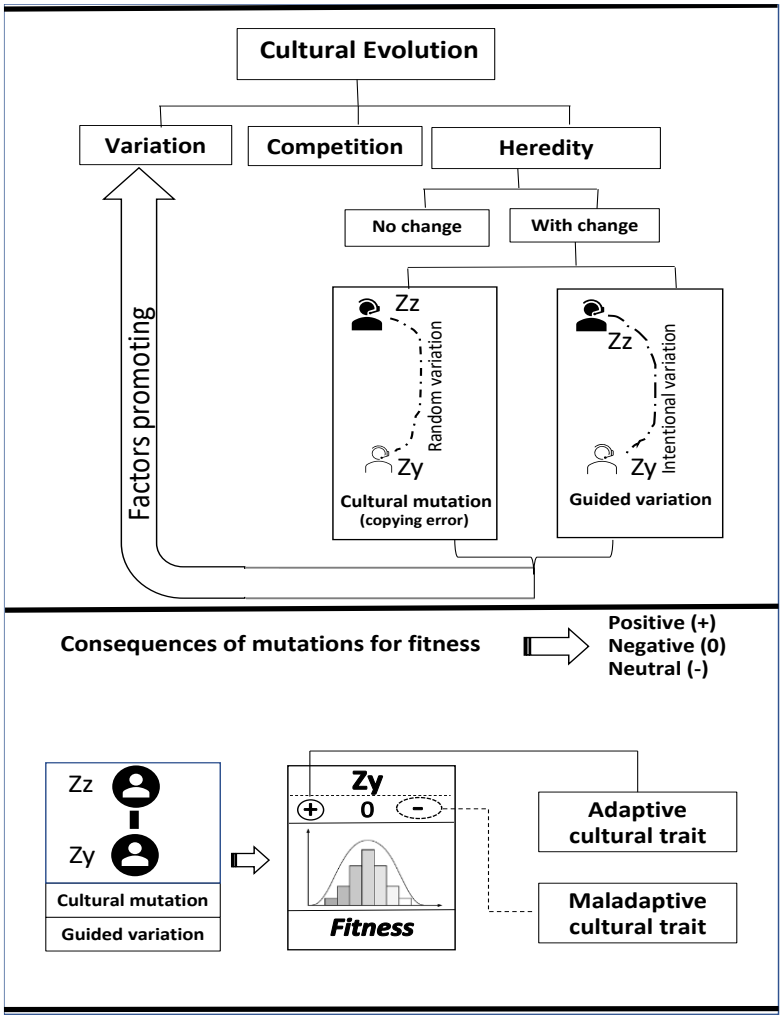

Figure 1. Processes that drives the occurrence of cultural evolution and the implications of modified information for the fitness of human cultures.

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Declarations

Conflict of interest

The authors declare that they have no conflict of interest.

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CAPÍTULO II

INVESTIGATING THE DYNAMICS OF CULTURAL MUTATIONS IN LOCAL MEDICINAL PLANT USE IN NE BRAZIL

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Investigating the dynamics of cultural mutations in local medicinal plant use in NE Brazil

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Research

Abstract

Background: According to cultural evolution theory (CE), the transmission of cultural information can be subjected to "cultural mutations" (random alteration of information). Cultural mutations can have implications for human culture. However, the contributing factors to the increased/decreased establishment of these processes in local medical systems remain unclear. Thus, we tested the following hypotheses: H1: more conservative transmission modes (vertical transmission) are less prone to cultural mutation; H2: knowledge sharing about a medicinal plant influences the occurrence of cultural mutations in local medical systems; and H3: information on versatile medicinal plants (plants used to treat various ailments) is more likely to undergo cultural mutation in local medical systems.

Methods: To test our hypotheses, we conducted a case study in the Lagoa do Junco community, Santana do Ipanema municipality, Alagoas. The data were collected through semistructured interviews with 120 individuals older than 18 years. Analyses utilized a generalized linear model (GLM) with the binomial and Poisson families.

Results: We found a lower cultural mutation rate for more conservative transmission modes ($p<0.01$). Information about more widely shared medicinal plants was more prone to cultural mutations ($p<0.001$). Versatile medicinal plants are more susceptible to cultural mutations.

Conclusions: Less conservative cultural transmission modes promote greater variation in plant-based medicinal systems. Factors such as information sharing and plant versatility, though important in local medical systems, may have implicationsfor human culture, as exemplified by maladaptive cultural traits, and need assessment in future studies.

Keywords: Cultural evolution, Copy errors, Ethnobotany, Medicinal plants

Background

Local medical systems are characterized by the set of knowledge and practices regarding health and disease management developed by human groups (Bizon 1973). Evidence indicates that social, cultural, biological, and ecological factors can influence the construction of these systems (Molares & Ladio 2014, Johns & Sibeko 2023, Albuquerque *et al*. 2023). Within local medical systems, various resources, including plants utilized for medicinal purposes, prevail in treating diseases. A striking feature of local medical systems is the transmission of information, which is treated as cultural information. Through the transmission of various theoretical and practical knowledge, strategies related to health promotion and disease by different human groups have been developed (Dunn 1976, Kleinman 1978). However, according to "cultural evolution theory" (CE), the transmission of cultural information may occur through unintentional copy errors, which are termed "cultural mutations" (Mesoudi 2011).

During the information transmission process, several factors can influence communication between individuals, resulting in cultural mutations. Among these factors are I) information concealment, in which individuals copy information inaccuracies that they do not perceive; II) incomplete transmission of information, in which only part of the information (of extensive and varied content) is transmitted or assimilated in the minds of individuals; and III) information confusion, in which people transmit probable information instead of suitable information (Arkes 1991, Barkow 1989, Eerkens & Lipo 2005, O'Brien *et al*. 2016).

The occurrence of cultural mutations has implications for human culture and can even be deleterious for some populations. As examples of the effects of cultural mutations, "Maladaptive Cultural Traits" represent adopted behaviors that do not contribute to individuals' adaptation (Barkow 1989). In the local medical system, these behaviors can be represented by plants used for medicinal purposes that do not possess the desired medicinal efficiency (Dantas *et al*. 2020, Pereira *et al*. 2021, Santoro *et al*. 2018).

It is possible that the occurrence of mutations in local medical systems is related to certain situations. For example, some studies have shown that people's knowledge of medicinal plants is more similar to that of their parents than to that of other community members (Brito *et al*. 2019, Santoro *et al*. 2020). In addition, studies have suggested that information transmission from parents to children (vertical route) may function as a more conservative route of information, generating lower rates of change over time than other transmission routes (Cavalli-Sforza & Feldman 1981, Hewlett & Cavalli-Sforza 1986, Reyes-García *et al*. 2009). This would occur because the transmission from parents to children would incorporate changes from one generation to another (Santoro *et al*. 2018), as well as because of the importance people place on information acquired from parents.

On the other hand, other evidence suggests that horizontal (between individuals of the same generation without parental relation) or oblique (between individuals of different generations without parental relation) transmission can promote more varied information and rapid changes (fewer conservative routes). Consequently, variations generated by horizontal and oblique routes promote higher rates of change in cultural evolution (Boyd *et al*. 2011, Mesoudi 2011, Santoro *et al*. 2018). Therefore, it is reasonable to expect that these pathways are more susceptible to cultural mutations. This may occur because the scenarios of the horizontal and oblique pathways may lead to greater acceptance of innovation in information than the vertical pathway (Cavalli-Sforza & Feldman 1981). Additionally, the oblique and horizontal pathways may have a broader scope than the vertical pathway since they allow the transmission of information among all individuals within the same generation and across different generations (Santoro *et al*. 2018), increasing the chances of greater information variation (Boyd *et al*. 2011) and, consequently, alterations in the information (Mesoudi 2011). However, much of what is known about the information associated with transmission routes still exists in studies related to cultural evolution that need to be tested in the context of human populations. Thus, taking the local medical system scenario as a model and seeking to determine the route generating a greater number of mutations, this study proposes to test the following hypothesis: H1: more conservative transmission modes are less prone to cultural mutation, as we expect the vertical route to have a lower frequency of traits with mutations than are the oblique and horizontal routes.

Additionally, the more times people transmit information to others, the more susceptible these pieces of information will be to random changes (Mesoudi 2011, Santoro *et al*. 2018). For example, person "A" tells information to person "B", and they

transmit it to person “C”; however, the information arrives at “C” with some alteration. In other words, the process is similar to that of the game Chinese whispers (Santoro *et al*. 2018) or the telephone game (Camargo *et al*. 2021), as the information transmitted can be altered in each person’s mind (Laland & Brown 2011). Considering the possibility of reconstructing the information in the minds of individuals, in this study, we also assessed the following hypothesis: H2: Knowledge sharing about a medicinal plant influences the occurrence of cultural mutations in local medical systems. A priori, our expectation is that more widely shared biocultural traits have a greater frequency of mutations.

Moreover, “causal mismatch” (Henrich & Mcelreath 2003) or “effect generalization” are also factors that can assist in understanding the generation of cultural mutations. The ability of versatile therapeutic potential plants (i.e., those with different disease symptoms) can contribute to the occurrence of cultural mutations. This is because the versatility of the medicinal uses of a plant can lead individuals to use it without understanding how, for what, or why certain species work, increasing the chances of transmitting altered information. In effect generalization, individuals associate information with other existing information. Therefore, in the case of versatile medicinal plants, people can make different information associations, increasing the chances of cultural mutations. Thus, considering the implications of the versatility of the use of medicinal plants, we also tested the hypothesis that H3: Information on versatile medicinal plants is more likely to undergocultural mutation in local medical systems. Our expectation is that biocultural traits with greater versatility in medicinal usehave a greater frequency of mutations.

Materials and Methods

Study Area

This study was conducted in the Lagoa do Junco community, located in the municipality of Santana do Ipanema in the stateof Alagoas, Northeast Brazil (Dantas *et al*. 2020). The municipality of Santana do Ipanema is in the mesoregion of the Alagoan Sertão, 207 km from the state capital, Maceió, and has a population of 48,232 inhabitants (IBGE 2021). The Lagoa do Junco community consists of 63 families, housing a total of 188 individuals. The community is situated in an area with caatinga vegetation, which is a type of seasonally dry tropical forest. Community members engage in extractive activities, such as collecting firewood and medicinal resources, on this vegetation. The region’s climate is semiarid, with an irregular rainfall distribution concentrated over a period of four to five months (Lopes *et al*. 2005). Within the community, there are educational, medical, commercial, and religious establishments. Additionally, the Lagoa do Junco Community is characterized by a strong tradition of using and commercializing medicinal plants (Dantas *et al*. 2020, Pereira *et al*. 2021). Furthermore, community members possess significant expertise in medicinal plants and often have lower incomes, a common situation in other areas of Northeast Brazil (Magalhães *et al*. 2022, Sousa *et al*. 2022, Oliveira *et al*. 2017), which is why they frequently resort to medicinal plants to address their health concerns. The strong history of using and selling medicinal plants prompted us to select this community for our study.

Figure 1. Lagoa do Junco Community, Santana do Ipanema municipality, Alagoas, Brazil. A. An overall view of the community. B. Street 1 of the community. C. Street 2 of the community. D. Conducting semistructured interviews with one of the community members**.**

Ethical and legal aspects

Data collection adhered to the guidelines of the Resolution (466/12) from the National Health Council for Research Involving Human Subjects, with the approval of the Ethics in Research Committee (CEP) of the University of Pernambuco-UPE, which granted the following approval number: CAAE: 97380918.9.0000.5207. Furthermore, the study was also conducted with registration from the National System for the Management of Genetic Heritage and Associated Traditional Knowledge- SISGEN under the number AB5C935 for accessing associated traditional knowledge. All participants willing to participate in this study were invited to sign the Free and Informed Consent Term (TCLE). Additionally, for botanical material collection, we used proof of registration from the Authorization and Information System in Biodiversity – SISBIO, under the number 64841-1, as recommended for collections carried out outside Conservation Units.

Verification of Cultural Mutations

The data for this study were collected between 2018 and 2019. Patients were diagnosed with medicinal plants by local residents older than 18 years (representing 82% of the adult population), for a total of 120 participants. The data were collected in two separate phases. In the initial phase, we employed the free-listing technique (Albuquerque *et al*. 2014), inviting all individuals to list plants known or used by them medicinally (**Supplementary Material).** Semistructured interviews were subsequently conducted (Albuquerque et al. 2014) to gather information about each plant mentioned by the respondents. Furthermore, semistructured interviews were also used to identify transmitting individuals (those who passed on information about medicinal plants in the local medical system) and learning individuals (those who learned information about medicinal plants in the local medical system) (Dantas *et al*. 2020). For instance, during the interviews, for every plantmentioned by respondents, we posed the following inquiries: 1) For which diseases or ailments is this plant indicated? 2) Which part/parts of the plant is used in treatment? 3) From whom did you acquire this knowledge?

After conducting the semistructured interviews, the information (considered biocultural traits) of the transmitting individuals was analyzed and compared with the information from the learning individuals of the local medical system to pinpoint potential instances of cultural mutations (Albuquerque *et al*. 2014). In this analysis, information about the same plant used by the learning individual and the information transmitter was taken into account. Information or a biocultural trait was deemed a mutation when 1) the therapeutic target (disease) indicated by a learning individual was different from what theinformation transmitter had indicated or 2) the plant part used by the learner was different from the information transmitter (Albuquerque *et al*. 2014).

Classification of Cultural Mutations or Guided Variation (second data collection phase)

Information alteration can occur unintentionally (cultural mutation) or intentionally (guided variation) (Mesoudi 2011). To ascertain whether the changes in information between individuals were truly unintentional (mutation), a new data collection phase was undertaken. This stage involved conducting fresh semistructured interviews solely with the learning and transmitting individuals who, in the first data collection phase, presented potential cultural mutation cases.

For this stage, each learning and transmitting individual in the local medical system was reminded of the information they had previously mentioned during the initial interviews. Subsequently, after jogging their memory, a series of inductive questions were posed, such as the following: 1) Days ago (first phase), you mentioned using plant *X* to cure disease *Y*. However, can this plant also be used to treat other types of diseases? If yes, which ones? 2) Have you used this plant to cure another disease in the past? If so, which? 3) Have you ever suggested this type of plant to someone to cure a different disease? If so, which? 4) Days ago, you mentioned using part *X* of this plant. However, can other parts of the plant be used as well? If so, which? From these questions, it was possible to determine whether the changes in information within the medical system between transmitting and learning individuals were random (cultural mutation) or intentional (guided variation). Here, is a hypothetical scenario for better illustration:

During the initial stage of the semistructured interviews, individual “A” mentioned using leaves from the “42ynthes” plant to alleviate headaches and learning about this practice from individual “B,” a resident of the community. When we interviewed individual “B,” they also confirmed using the “42ynthes” plant for headaches but specified using the bark, not mentioning the use of leaves as reported by individual “A.” Upon concluding the initial data collection and analyzing the interviews, we identified a discrepancy in information between the two participants. However, we did not ascertain whether this difference was an r cultural mutation or a guided variation.

To investigate whether this change was a cultural mutation or intentional variation, we conducted new interviews (second stage of data collection) with individuals “A” and “B.” During this phase, we posed the following question to individual “A”:

"A few days ago, you mentioned using the leaves of the "43ynthes" plant to alleviate headaches. However, have you ever used or do you currently use other parts of the "43ynthes" plant for this purpose? If yes, which ones?" Individual "A" then disclosed that they had previously used the bark of the "Aroeira" plant to treat headaches, but despite the suggestion to use the bark, they now preferred the leaves because of their "better taste." In the interview with individual "B," we asked, "In addition to using the bark, have you ever recommended to someone else another part of the "43ynthes" plant for treating headaches?" Individual "B" stated that they had always used only the bark of the "Aroeira" plant for this purpose and had consistently recommended solely the use of the bark.

In this context, we confirmed that the information change was a guided variation, as individual "A" consciously adapted the information, preferring the leaves of the "43ynthes" over the suggested bark by individual "B." However, if individual "A" had asserted during the interview that they had always used and continue to use only the leaves of the "43ynthes" plant to treat headaches, without mentioning or being aware of the use of the bark, we would consider this a cultural mutation, indicating a spontaneous deviation in information without evidence of intentional alteration.

Botanical Material Collection and Identification

We employed the guided-tour technique (Albuquerque *et al*. 2014) for collecting plant species. Following the semistructured interviews, each participant was invited to display the medicinal plants they had at their homes or nearby homes. A total of39 species were documented. Botanical material from these species was collected for identification by specialists, and the specimens were deposited at the Agronomic Research Institute of Pernambuco (IPA).

Data analysis

To test our hypotheses, we employed a generalized linear model (GLM) using R software version 3.4.3 (2017). The acquisition and categorization of information transmission modes were conducted through the analysis of specific questions posed during the initial data collection with the individuals included. For instance, at the commencement and conclusion of semistructured interviews, participants were asked various questions, including the following:

1. How old are you?
2. Who are your relatives in the community?
3. From whom did you acquire knowledge about medicinal plants?
4. Is this person a relative of yours?
    - If yes, specify the degree of the relationship (uncle, aunt, mother, father, grandmother, grandfather, cousin, etc.).
    - If not, what is the nature of your relationship with this person (friend, neighbor, etc.)?

These questions allowed us to analyze information from all the transmitting and learning participants in the local medical system. Ultimately, we categorized transmission as vertical when information was passed from parents to children, horizontal when information was exchanged among individuals of the same generation, and oblique when information was shared between individuals of distinct generations without a familial connection.

The relationship between the versatility and popularity of medicinal plants (measured by citation frequency) was assessed using simple linear regression.

To assess whether H1: more conservative transmission modes are less prone to cultural mutation occurrence, we created a spreadsheet recording informant names and all the cultural traits (plant+ part of the plant used in treatment+ disease indicated for treatment) mentioned by them. In addition to the cultural traits mentioned by informants, "1" was assigned if the information had mutated, or "0" was assigned if it had not. Additionally, we noted the cultural trait transmission mode (vertical, horizontal, or oblique). Finally, we used a generalized linear model (GLM) with a binomial family, considering the dependent variable as the mutation variable and the independent variable as the individual learning factor.

To test H2, that the sharing of knowledge about a medicinal plant influences the occurrence of cultural mutations in local medical systems, we designed a spreadsheet recording all the plants mentioned by the informants. In addition to each plant name, we added the number of people who mentioned information about each plant. Furthermore, in another column, we assigned the number of times a mutation occurred for each species (e.g., "1" for one mutation associated with a species and "2" for two mutations associated with a species). We then utilized a generalized linear model (GLM) using the Poisson family, considering the independent variable as the number of people citing each plant and the dependent variable as the number

of times a cultural mutation occurred for each plant.

To test whether H3: Information about versatile medicinal plants is prone to greater cultural defects in local medical systems, the relative importance (RI) index of plant species was first calculated as per Bennett & Prance (2000), where versatile species have more medicinal properties and body systems. The following formula was used: RI = NSC+NP, where RI = relative importance, NSC = number of body systems and NP = number of properties. The following formulas were used for calculating NSCs and NPs: 1) NSC=NSCE÷NSCEV, where NSCE is the number of body systems treated by a particular species and NSCEV is the number of body systems treated by the most versatile species; 2) NP=NPE÷NPEV, where NPE is the number of medicinal functions attributed to a particular species and NPEV is the total number of medicinal functions attributed to the most versatile species. After calculating the relative importance index, we designed a spreadsheet noting the names of all the plants mentioned by the informants. In addition to each plant name, we added the RI value of the plant, and in addition to the RI value, we added the number of times a mutation occurred for each species (e.g., "1" for one mutation case linked to a species and "2" for two mutation cases linked to a species). We then used a generalized linear model (GLM) employing the Poisson family, considering the independent variable as the RI value of each plant and the dependent variable as the number of times a cultural mutation happened for each plant.

Results

We found a significant relationship between plant popularity and usage versatility ($F=98.48$, $p<0.01$). The cultural mutation rate was lower for vertical transmission than for oblique or horizontal transmission ($p<0.01$), and information about widely shared medicinal plants was more prone to cultural mutations ($p<0.001$). Additionally, versatile medicinal plants are more susceptible to cultural mutations ($p<0.001$), confirming our expectations (Table 1).

Table 1. Generalized linear model with binomial and Poisson families showing 1) the association between different cultural transmission routes and the occurrence of cultural mutations, 2) the association between a greater amount of shared medicinal plant information and the occurrence of cultural mutations, and 3) the association between the versatility of medicinal plant usage and the occurrence of cultural mutations.

GLM (Hypothesis 1)				
I estimated	**Std. Error**	**Z Value**	**Pr(>|z|)**	**AIC**
Intercept -2.4342	0.1844	-13.203	<2e-16***	545.93
Road comparison vertical with horizontal	0.8845	0.2704 3.272	0.00107**	
Road comparison vertical with oblique	0.7896	0.2768 2.853	0.00433 **	
GLM (Hypothesis 2)				
I estimated	**Std. Error**	**Z Value**	**Pr(>|z|)**	**AIC**
Intercept -1.160902	0.270975	- 4.284	1.83e-05 ***	100.9
Quote 0.042747	0.003621	11.806	< 2e-16 ***	
GLM (Hypothesis 3)				
I estimated	**Std. Error**	**Z Value**	**Pr(>|z|)**	**AIC**
Intercept -2.2560	0.3762	-5.997	2.01e-09 ***	113.06
RI 2.5520	0.2328	10.963	< 2e-16 ***	

The most frequently mentioned transmission route was vertical, with a total of 397 biocultural traits and 32 cultural mutations. The horizontal route had a total of 177 biocultural traits with 31 mutations, and the oblique route had 173 biocultural traits with a total of 28 mutations.

Discussion

Do more conservative modes of transmission have lower tendencies for cultural mutations?

Our findings support the prediction that vertical transmission can act as a more conservative route for accessing cultural information than can other transmission pathways (Cavalli-Sforza & Feldman 1981, Hewlett & Cavalli-Sforza 1986, Reyes- García *et al*. 2009). Several factors may contribute to this. First, parent-to-child transmission typically results in changes accumulating from one generation to the next (Santoro *et al*. 2018), whereas oblique and horizontal pathways facilitate the sharing of cultural traits among all individuals within and across generations (Mesoudi 2011). This might amplify information diversity (Boyd & Richerson 2011) and, in turn, the emergence of cultural mutations.

Relevant studies in evolutionary psychology, particularly those associated with adaptive memory, suggest that over time, human memory systems have evolved to better retain information deemed crucial from an adaptive perspective (Nairne & Pandeirada 2008, Nairne *et al*. 2008, Nairne *et al*. 2007, Nairne *et al*. 2009, Nairne *et al*. 2012). Thus, in the community we studied, knowledge acquired from parents (vertical transmission) might be perceived as more important and, therefore, better retained and transmitted with fewer errors than information obtained through other transmission routes. The emphasis individuals place on parentally acquired knowledge could be attributed to various factors, such as family traditions, parental care involving the use of medicinal plants since childhood (Eyssatier *et al*. 2008, Henrich 2011, Santoro *et al*. 2020), and viewing parents as primary local role models for cultural information (Wood *et al*. 2012). The extent to which these factors influence perceived importance and the occurrence of cultural mutations needs further evaluation to better understand the conservative nature of vertical transmission.

Another reason why vertical transmission may yield fewer cultural mutations is its dominance over oblique and horizontal transmission in local medical systems (Santoro *et al*. 2020). Individuals often learn through vertical channels more than oblique and horizontal channels. This preference was evident in our study and has been highlighted in other research concerning medicinal plants in various local medical systems (Brito *et al.* 2019, Santoro *et al*. 2020). Consequently, frequent events may affect how we prioritize specific details in memory and cultural transmission (Sachs *et al*. 2017, Scheideler *et al*.2017, Silva *et al*. 2022).

Furthermore, some studies suggest that information provided by exemplary individuals (those perceived as vast reservoirs of knowledge or skill in cultural contexts) tends to be more widely transmitted and memorable than that from other sources (Henrich 2009, Jiménez & Mesoudi 2020). Moreover, evidence implies that the more often people replicate information from a model, the less likely they are to experience copying errors (Schillinger *et al*. 2015). In our research, parents were most frequently cited as information sources, indicating that within the community we examined, parents are considered paramount in acquiring local knowledge. This perception could stem from the inherent trust in parental advice or the ease of accessing information from parents. Therefore, this trust may lead to better retention of cultural traits linked with vertical transmission, subsequently resulting in fewer cultural mutations. However, further studies are needed to confirm this observation.

Does sharing knowledge about a medicinal plant influence the occurrence of cultural mutations in local medical systems?

Our data suggest that more widely shared information about medicinal plants is more prone to cultural mutations. According to certain premises of cultural evolution, when specific information undergoes repeated transmission, the probability of anerror surges. The more individuals relay information, the more susceptible they become to random modifications (Mesoudi2011, Santoro *et al*. 2018). This phenomenon arises because as information circulates, each recipient may alter it slightly in their mind (Laland & Brown 2011). Thus, public dissemination can muddle information since individuals might convey probable information instead of the precise, intended data (Barkow 1989).

A prime illustration of this is the “Chinese Whispers” game (Santoro *et al*. 2018) or “Telephone” (Camargo *et al*. 2021). Here, participants form a line or circle, and the first player shares a message, whispering it into the ear of the next person, thereby passing the information from one individual to another. Ultimately, the final participant announces their received message, contrasting it with the original (Utami & Rahmawati 2018). These games inevitably alter the initial message through transmission, mirroring the concept of cultural mutations in cultural evolution.

The propensity for widely shared medicinal plant information to be susceptible to cultural mutations might explain why redundant studies uncover a greater number of redundant medicinal plants for frequently targeted therapies (Santoro *et al*. 2015).

Redundant medicinal species are those with identical functions, such as several species used to treat the same ailment (Santoro *et al*. 2015). Common therapeutic targets are those with high incidences throughout the year, such as colds, headaches, and fever. Thus, in local medical systems, some species might become redundant due to cultural mutations. For instance, in one scenario, Person A informs Person B that a particular plant cure headaches. However, Person B might assimilate this as the plant cures colds instead of headaches, as initially conveyed. In another instance, Person C tells Person D that a specific plant remedies diarrhea. However, Person D might assume that the plant treats colds and not diarrhea, as first suggested. In these examples, although the medicinal plants differ and were recommended for distinct ailments, cultural mutations made them redundant in the system. Both now serve the same medicinal function (curing colds). We did not investigate the relationship between species redundancy and cultural mutations in this work, but we believe this topic is anintriguing avenue for future research.

Conversely, our findings contrast with those of several archaeological studies probing the emergence and transmission of copying errors. For instance, via a laboratory experiment with human groups, Acerbi & Tennie (2016) explored how the frequency of shared artifact information might influence cultural transmission fidelity. Contrary to our findings, they discerned that the more participants shared artifact details, the likelier the faithful transfer of cultural information. This discrepancy might arise because artifact information is less intricate than other resource information, leading to easier memorization compared to that of other resources, such as plants. Thus, a connection might exist between information sharing and the onset of cultural mutations, contingent on the content transmitted by humans. This relationship warrants further exploration in future studies.

Are versatile medicinal plants more susceptible to cultural mutations in local medical systems?

As anticipated, we found a link between the versatility of medicinal plant usage and the incidence of cultural mutations. We believe several factors contribute to this difference in incidence in local medical systems. One such factor is “causal mismatch” (Henrich & McElreath 2003). As versatile medicinal plants are recommended for various health issues, individuals might struggle to remember the exact function(s) of the plant species relayed via cultural transmission.

Additionally, individuals might be associating prior information before passing it to a new person, potentially leading to a generalization of effects before transmission. Trust in the therapeutic potential of a versatile plant might prompt them to form various information associations, heightening the chances of cultural mutation. For example, an individual might be informed that Plant *X* cures colds, diarrhea, and headaches. However, the recipient might use Plant *X* to remedy migraines,either because they equate migraines and headaches to the same bodily system or because they perceive similar symptoms. Consequently, the individual might rely on another plant *X* that remedies colds, diarrhea, and migraines, diverging from theoriginal information and thus resulting in a cultural mutation (Dantas *et al*. 2020).

Moreover, studies on copying errors tied to cultural transmission highlight that information content variation can significantly influence cultural information fidelity (Acerbi & Tennie 2016). Therefore, as versatile medicinal plants can be used for multiple symptoms, when compared to less versatile ones, information variation for the former might foster a greater occurrence of cultural mutations. It is also worth noting the potential mutual influence between cultural mutations and plant versatility. As versatile medicinal plants can cause cultural mutations, these mutations could also enhance the versatility of certain plant species. For instance, in a local medical system, a cultural trait might indicate that Plant *X* cures colds and diarrhea. However, during transmission, one individual might convey that Plant *X* remedies headaches and colds.The recipient, assimilating the mutated information, will use the plant for a new ailment (headaches). If this mutation is relayed to others in the local medical system, Plant *X’s* therapeutic versatility can increase, making understanding of these medical systems intricate. Initially, versatility leads to increased mutation, enabling cultural evolution even when based on inefficacious information and potentially increasing the pressure on the collection of some plant species. These mutations might subsequently be linked to new data, suggesting previously unused plants for specific therapeutic purposes and further exacerbating collection pressure. Thus, regarding medicinal resources, cultural evolution and mutations might exacerbate species conservation issues, contingent on the plant part used and collection frequency and intensity.

Notably, simple linear regression analysis indicated a relationship between the popularity and versatility of the medicinal plants in our study. These findings suggest that the more popular plants in the local medical system also exhibit a greater incidence of cultural mutation due to their versatility. Thus, we posit that the versatility of medicinal plants allows for greater variation in the information available for the most popular plants, favoring a higher mutation rate for these resources.

Conclusion

This study is among the pioneers highlighting cultural mutations within human populations based on medicinal plant use. Our findings reinforce the cultural evolution theory and showcase that knowledge transmission about medicinal plants plays a pivotal role in spawning mutations in local medical systems.

Additionally, our study has significant implications for understanding local medical systems and the ethnobotanical domain. For instance, our data demonstrate that learning about medicinal plants from parents may reduce errors compared to learning from others. Thus, if parental learning minimizes errors due to its conservative nature, it becomes imperative for future studies to discern whether vertically obtained information offers greater adaptive value for human cultures than information from other transmission routes.

Furthermore, although plant versatility is deemed essential in ethnobotanical studies, our findings reveal that this characteristic might also have negative adaptive value due to its propensity to amplify cultural mutations. Versatility in medicinal use might contribute to poorly adapted traits in local medical systems, a concept requiring comprehensive exploration in subsequent studies. For instance, in bioprospective studies in which plants are selected based on versatility, species with maladapted cultural traits might be chosen. Hence, our study's findings pave the way for innovative research on medical systems, aiming to decipher the evolutionary factors culminating in poorly adapted trait accumulation in medical systems and assessing the ramifications of cultural mutations for human populations. It is necessary for studies of this nature to be conducted in a greater number of communities with plant use traditions to ensure robust generalizations.

Limitations

Given that cultural mutation studies in medical systems are incipient, potential methodological limitations might skew our findings, such as informant memory constraints and nonlinearity in learning. For example, an individual might learn about a plant from Person *X* and to increase their knowledge about another plant use with Person *Y*. However, during interviews, the informant might only recall Person *X*, their primary knowledge source, introducing bias in recording the information's transmission route (whether vertical or not). Considering that knowledge can be obtained from multiple sources, we propose that subsequent cultural mutation studies employ methods or strategies to sidestep such biases.

Depending on social-ecological context, cultural learning might be far more intricate than mere person-to-person transmission regarding a medicinal plant. Although adaptive thinking is based on learning and experience, people may continue using inefficient plants to treat illnesses because there may be a delay in people's perception of the efficiency of the medicinal use of a given plant, as also highlighted by Tanaka *et al*. (2009). Furthermore, sometimes using a plant may work for one person and not work for another. Therefore, it is possible to continue to use plants that are not effective at treating certain diseases. Although there is a relationship between versatility and the frequency of mutations, this relationship must be considered with caution, as there may be other factors not considered in this study that influence thisrelationship.

Declarations

List of abbreviations: EC: Cultural evolution; IBGE: Brazilian Institute of Geography and Statistics; TCLE: Informed consent form; GLM: Generalized linear model; IPA: Agronomic Research Institute of Pernambuco; CEP: Research Ethics Committee; RI: relative importance index; NSC: Number of Body Systems; NP: Number of properties; NSCE: Number of body systems treated by a particular species; NSCEV: Number of body systems treated by the most versatile species; NPE: Number of medicinal functions attributed to a particular species; NPEV: Total number of medicinal functions attributed to the most versatile species.

Ethical Approval and Participant Consent: The study was submitted and approved by the Research Ethics Committee of the University of Pernambuco under registration number CAAE: 97380918.9.0000.5207. It was also registered with the National System for the Management of Genetic Heritage and Associated Traditional Knowledge-SISGEN, under the number AB5C935, and the Authorization and Information System in Biodiversity- SISBIO, under the number: 64841-1, as suggested for collections carried out outside Conservation Units. All the participating individuals were informed of the purpose of this study and were asked to sign the informed consent form.

Consent for Publication: Not applicable.

Availability of Data and Materials: The data generated by this study are available upon request.

Competing interests: The authors declare no conflicts of interest.

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Author Contributions: Janilo Italo Melo Dantas conducted the fieldwork, statistical analysis, and manuscript writing. André Luiz Borba do Nascimento contributed to the statistical analysis and manuscript writing. Taline Cristina da Silva contributedto the writing of the manuscript. Ulysses Paulino Albuquerque and Elcida de Lima Araújo participated in the study's conception, analysis, and manuscript writing.

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Supplementary Material: List of medicinal plants used by the Lagoa do Junco community in the Municipality of Santana do Ipanema-Alagoas, Brazil.

Popular name	**Scientific name**	**Botanical Family**	**Voucher**	**Relative Importance**
Aroeira	*Myracrodruon urundeuva* (M.Allemão) Engl.	Anacardiaceae	Dantas. JIM 929563	1.54
Seriguela	*Spondias purpurea L.*	Anacardiaceae	Dantas. JIM 92947	0.29
Babosa	*Aloe vera* (L.) Burm. f.	Asparagaceae	Dantas. JIM sterile	1.52
Grajaú	*Fridericia chica* (Bonpl.) L.G.Lohmann	Bignoneaceae	Sterile	0.29
Umburana	*Commiphora leptophloeos* (Mart.) J.B.Gillett	Burseraceae	Dantas. JIM 92951	0.94
Rabo de Raposa	*Harrisia adscendens* (Gurke)Britton e Rose	Cactaceae	Dantas. JIM 93420	0.58
Muçambê	*Tarenaya spinosa* (Jacq.) Raf.	Cleomaceae	Dantas. JIM 92702	0.58
Pratudo	*Kalanchoe crenata* (Andrews) Haw.	Crassulaceae	Dantas. JIM 92699	2
Bom Nome	*Monteverdia rigida* (Mart.) Biral	Celastraceae	Dantas. JIM 92952	0.58
Melão de São Caetano	*Momordica charantia* L.	Cucurbitaceae	Dantas. JIM 92696	0.29
Pião Roxo	*Jatropha gossypiifolia* L.	Euphorbiaceae	Dantas. JIM 92700	0.29
Quebra Pedra	*Phyllanthus amarus* Schumach. & Thonn.	Euphorbiaceae	Dantas. JIM 92956	0.29
Carrapateira (Mamona)	*Ricinus communis* L.	Euphorbiaceae	Dantas. JIM 92705	0.67
Hortelã da Folha Pequena	*Mentha villosa* Huds.	Lamiaceae	Dantas. JIM 92949	1.43
Sambacaitá	*Mesosphaerum pectinatum* (L.) Kuntze	Lamiaceae	Dantas. JIM 929562	0.87
Manjericão	*Ocimum americanum* L.	Lamiaceae	Dantas. JIM 92948	1.23
Hortelã da Folha Grande	*Plectranthus amboinicus* (Lour.) Spreng.	Lamiaceae	Dantas. JIM 929560	1.81
Boldo	*Plectranthus ornatos* Codd.	Lamiaceae	Dantas. JIM 949561	1.34
Alecrim	*Rosmarinus officinalis* L.	Lamiaceae	Dantas. JIM 949510	1.05
Mororó	*Bauhinia cheilantha* (Bong.)	Fabaceae	Dantas. JIM 92953	0.76

	Steud.			
Jatobá	*Hymenaea courbaril* L.	Fabaceae	Dantas. JIM 93419	0.58
Catingueira	*Poincianella pyramidalis* (Tul.) L.P.Queiroz	Fabaceae	Dantas. JIM 92944	0.58
Angico	*Anadenanthera colubrina* var. *cebil* (Griseb.) Altschul	Fabaceae	Dantas. JIM 92955	1.05
Tamarindo	*Tamarindus indica* L.	Fabaceae	Dantas. JIM 92701	0.29
Mulungú	*Erythrina velutina* Willd.	Fabaceae	Dantas. JIM 92959	0.47
Romã	*Punica granatum* L.	Lythraceae	Dantas. JIM 92697	0.87
Acerola	*Malpighia emarginata* Dc.	Malpighiaceae	Dantas. JIM 92945	0.29
Hibisco	*Hibiscus rosa-sinensis* L.	Malvaceae	Dantas. JIM 92707	0.29
Pitanga	*Eugenia pitanga* L.	Myrtaceae	Dantas. JIM 92703	0.29
Goiabeira	*Psidium guajava* L.	Myrtaceae	Dantas. JIM 92706	0.29
Capim Santo	*Cymbopogon citratus* (DC.)Stapf	Poaceae	Dantas. JIM 929564	1.34
Juazeiro	*Sarcomphalus joazeiro* (Mart.) Hauenschild	Rhamnaceae	Dantas. JIM 92698	0.67
Noni	*Morinda citrifolia* L.	Rubiaceae	Dantas. JIM 93422	0.38
Pé de Limão	*Citrus* sp.	Rutaceae	Dantas. JIM 92708	0.29
Laranjeira	*Citrus aurantium* L.	Rutaceae	Dantas. JIM 92954	0.96
Quixabeira	*Sideroxylon obtusifolium* (Roem. & Schult.) T.D.Penn	Sapotaceae	Dantas. JIM 92946	0.96
Pimenta	*Capsicum frutescens* L.	Solanaceae	Dantas. JIM 93421	0.58
Erva Cidreira	*Lippia alba* (Mill.) N.E.Br. ex Britton & P.Wilson	Verbenaceae	Dantas. JIM 92704	1.90
Testa de Touro	*Kallstroemia tribuloides* (Mart.) Steud.	Zygophyllaceae	Dantas. JIM 92950	0.29

CAPÍTULO III

THE INFLUENCE OF PRESTIGE BIAS ON KNOWLEDGE AND THE DYNAMICS OF CULTURAL TRANSMISSION ABOUT MEDICINAL PLANTS IN LOCAL MEDICAL SYSTEMS

(Artigo submetido na revista Ethnobotany Research and Aplications)

Link para as normas da revista: https://ethnobotanyjournal.org/index.php/era/about/submissions)

The Influence of Prestige Bias on Knowledge and the Dynamics of Cultural Transmission about Medicinal Plants in Local Medical Systems

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Abstract

Background: Cultural transmission is crucial in social-ecological systems, such as local medical systems. According to the Theory of Cultural Evolution (CE), the information transmitted can change, either through cultural mutations (random) or guided variations (intentional). In local medical systems, this cultural transmission can be selective. For example, individuals tend to replicate information from prestigious social models, who generally have specialized knowledge in the area of interest. This phenomenon is known as "Prestige Bias". This study investigated how prestige bias affects knowledge and cultural transmission dynamics related to medicinal plants in local medical systems. The hypotheses tested were: H1: prestigious individuals have more knowledge about medicinal plants than those less prestigious; H2: information about medicinal plants from prestigious sources is less prone to cultural mutations than information from less prestigious sources; and H3: prestigious individuals promote more guided variation than cultural mutation.

Methods: We examined the local medical system in the community of Lagoa do Junco, in Santana do Ipanema, Alagoas. We collected data through semi-structured interviews with 120 community residents and analyzed them using the Wilcoxon -Mann-Whitney test and a generalized linear model (GLM) in the R development environment.

Results: People who are recognized as prestigious have greater knowledge about medicinal plants. However, we did not observe a significant influence of prestige bias on reducing cultural mutations. Furthermore, it was found that prestigious individuals promote more guided variation than cultural mutation.

Conclusions: This study reveals that prestige directly influences the dynamics of cultural evolution in local medical systems.

Keywords: Cultural evolution, Copy errors, Ethnobotany, Medicinal plants

Background

Local medical systems can be considered social-ecological systems (Alencar et al. 2014, Albuquerque et al. 2023) and reflect the existence of diseases and the healing strategies people began to use to treat illnesses (Kleinman 1978). Within local medical systems, the transmission of cultural information is a fundamental process for their functioning, as many of the adaptive strategies used in the treatment of certain illnesses, such as the use of medicinal plants, occur through the transmission of cultural information (Nascimento et al. 2016, Dantas et al. 2020, Soldati & Albuquerque 2012, Santoro et al. 2020). Furthermore, in local medical systems, it is possible to infer that transmitting cultural information provides social learning and enables the maintenance or advancement of local knowledge.

According to the "Cultural Evolution Theory" (CE) (a theoretical field that seeks to explain the evolution of culture over time), information that is transmitted culturally is likely to change (Mesoudi 2011). For EC, culture evolves, and this evolution occurs mainly through the dynamics of cultural transmission. Changes may even occur in the information that is transmitted. When the information that is transmitted is randomly changed by people, this process is called "Cultural Mutation" (Mesoudi 2011, Dantas et al. 2020). On the other hand, when the transmitted information is intentionally changed, this process is called "Guided Variation" (Mesoudi 2011). Both cultural mutation and guided variation are processes already shown to occur in local medical systems (Dantas et al. 2020, Pereira et al. 2021, Dantas et al. 2024). Consequently, the occurrence of these phenomena can generate implications for human beings, and an example of this is the establishment of " Malely Adapted Biocultural Traits, "which represent adopted behaviors that do not benefit the adaptation of human beings (Santoro et al. 2018). In local medical systems, maladapted traits can be exemplified by using medicinal plants, which do not have the desired medicinal efficiency (Santoro et al. 2018, Dantas et al. 2020).

In the context of local medical systems, cultural transmission can occur selectively due to the social factors and strategies people use to acquire and transmit information (Santoro et al. 2018). As an example of this, "Prestige Bias" stands out. (Henrich & Gil-White 2001). Prestige bias occurs when people copy information from more successful people in a population (Henrich & Gil-White 2001). Transmission through prestige makes it possible to highlight individuals in a population who are seen as models, as they have considerable social status and high knowledge on the subject or information intended to be acquired (Reyes-Garcia et al. 2008). An example is copying some information or behaviors from community leaders,

famous people, and village elders (Horner et al. 2010).

Prestige bias has considerable importance in transmitting cultural information (Henrich & Gil-White 2001, Jiménez & Mesoudi 2020), and there is evidence that the strategy of copying prestigious individuals is not exclusive to the human population, as it also occurs in other populations of animal species (Horner et al. 2010). In local medical systems, prestige bias may be decisive in their structuring because people often trust the information acquired from these individuals (Santoro et al. 2018). However, despite evidence associated with prestige bias, we still do not know how this bias has influenced the dynamics of cultural evolution in local human populations, establishing cultural mutations and guided variation in local medical systems. Therefore, in this study, we propose to investigate the influence of prestige bias on knowledge and the dynamics of cultural transmission about medicinal plants in local medical systems, testing some hypotheses based on the previous knowledge exposed. For example, evidence indicates that prestigious individuals generally have high knowledge or superior skills on a given subject within a population (Jiménez & Mesoudi 2020). Thus, we tested the following hypothesis: H1: prestigious individuals have more knowledge about medicinal plants than less prestigious. We expect that there will be a greater proportion of information about medicinal plants for prestigious people than for other transmission sources.

Additionally, prestige bias can be considered an important factor in shaping the dynamics of human cultural evolution (Henrich & Gil-White 2001, Berl et al. 2021, Oliveira et al. 2023). Furthermore, some studies show that prestige emerged from psychological adaptations, to improve the quality of the information acquired (Henrich & Gil-White 2001). Other studies indicate that information from prestigious people may be better transmitted and more likely to be memorable than information from non-prestigious sources (Jiménez & Mesoudi 2021, Oliveira et al. 2023). Furthermore, in local medical systems, due to the experiences that prestigious individuals have, for the person needing the information, the prestige route may be perceived as the most important/advantageous when compared to information acquired through other routes of streaming. Consequently, this may be a key factor in making this information more easily memorized and recalled (Nairne & Pandeirada 2008). Based on these arguments, we sought to investigate the following hypothesis: H2: information about medicinal plants from prestigious sources is less prone to cultural mutations than information from less prestigious sources. We expect the frequency of mutated cultural traits to be lower when obtained by prestigious people than through other transmission sources.

We also sought to test whether H3: prestigious individuals promote more guided variation than cultural mutation. We expect the information change rate by prestigious people will be higher for guided variation than for cultural mutation. This may occur because prestigious people have much knowledge and, perhaps, diverse personal experiences (Henrich & Gil-White 2001, Jiménez & Mesoudi 2020, Reyes-Garcia et al. 2008). These facts may contribute to these prestigious individuals having a greater ability to alter information for themselves intentionally. Furthermore, the experience that these individuals have with medicinal plants may help them to memorize cultural information better.

Materials and Methods

The Local Medical system

The study was developed based on knowledge about medicinal plants in the local medical system of the community of Lagoa do Junco, located in Santana do Ipanema, Alagoas,

Northeast region of Brazil. The municipality of Santana do Ipanema is located in a semiarid environment dominated by caatinga vegetation (IBGE 2018). The Lagoa do Junco Community is considered one of the main local populations in the municipality, with a total of 63 registered families with an average of 188 individuals (Dantas et al. 2020, Pereira et al. 2021, Dantas et al. 2024). The people of the Lagoa do Junco community have direct contact and a very strong relationship with the municipality's natural resources, emphasizing a local forest around the community. Its medical system includes several cultural practices, such as the use of medicinal animals, the use of wood resources, and mainly the use of medicinal plants.

The use of medicinal plants is highly prominent in the community, with medicinal plants in isolation and through medicinal preparations (syrup, lickers, bottles), both for individual use and local commercialization (Dantas et al. 2020). The community's people have a local medical system characterized by a strong cultural knowledge of medicinal plants, which is why we selected the community for the study.

Ethical and Legal Information

Ethical recommendations for research with human beings were met. We had approval from the Research Ethics Committee of the University of Pernambuco-UPE CAAE: 97380918.9.0000.5207. We also registered our research with the National System for Management of Genetic Heritage and Associated Traditional Knowledge-SISGEN. We use the Free and Informed Consent Form (TCLE) for people to express their consent to participate in the present work.

Data collection

For data collection, we followed the same methodology used by Dantas et al. (2020) and Pereira et al. (2021), and the description of methods partially reproduces its wording. The collection was carried out in two stages. In the first stage, we used the free listing technique (Albuquerque et al. 2014), with each participating individual invited to mention the plants that were used or known to them as medicinal plants. Subsequently, we conducted semi-structured interviews (Albuquerque et al. 2014), with participants to acquire information about the uses of the listed plants and about the people in the community who had transmitted information about the uses of the plants. Based on these interviews, we identified the transmitting individuals (the person who transmitted the information in the local medical system) and learning individuals (the person who learned the information in the local medical system) (Dantas et al. 2020). We also asked questions during the interviews to identify which individuals were considered prestigious in the community. For example, during the interviews, we asked the following questions: 1) For which diseases or illnesses is this plant recommended? 2) Which part/parts of the plant do you use in the treatment? 3) Who did you obtain this knowledge from? 4) Who in the community do you consider to be experienced and know much about medicinal plants? Question 3 helped to identify individuals who are apprentices and transmitters of the local medical system, and question 4 helped to identify people with prestige in the community.

Using the guided tour technique (Albuquerque et al. 2014), we collected samples of all the plants mentioned by the informants. Subsequently, to identify the species, we consulted botanical experts, and all specimens were deposited at the Institute of Agricultural Research of Pernambuco-IPA.

Checking for Cultural Mutations

The information provided in the interviews of individuals identified as transmitters and learners was analyzed and compared to identify possible cases of cultural mutations among local knowledge (Dantas et al. 2020). When analyzing the information, we consider information about the same plant used by the learning individual and the individual transmitting the information. From this, we consider mutation when: 1 - the therapeutic target (disease) indicated by a learning individual was different from that indicated by the individual transmitting the information; 2 - when the part of the plant used by the apprentice was different from the information given by the transmitting individual (Dantas et al. 2020).

Classification of Cultural Mutation or Guided Variation (second stage of data collection)

After checking possible cases of cultural mutation in local knowledge, we carried out a new stage of semi-structured interviews only with individuals who were apprentices and transmitters who presented possible cases of mutation in their information. This stage was carried out at a different time from the first stage, with each individual initially remembering the information they spoke during the first data collection stage. The individual then answered some questions: 1) In the first interview, you mentioned that you used plant X to cure disease Y. However, can this plant also cure another type of disease? If yes, which one? 2) Have you used this plant to cure another disease? If yes, which one? 3) Have you ever recommended this type of plant to someone to cure another disease other than this? If yes, which one? 4) In the first interview, you mentioned using part X of this plant. However, can other parts of the plant also be used? If yes, which one? From these questions, it was possible to verify whether the information changes in the medical system between transmitting individuals and learning individuals were random (cultural mutation) or intentional (guided variation).

Data analysis

The identification of people recognized as prestigious was based on information from the interviewee, as at the end of each interview, the interviewee was asked to indicate who in the community he considered to be experienced and who had great knowledge about medicinal plants. To verify whether prestigious individuals know more about medicinal plants than those less prestigious (H1), we created a spreadsheet recording all participating individuals' names. Next to each participant's name, we included the number of medicinal plants mentioned by each individual. In addition, we also included the profile of each individual (whether they were an individual recognized as prestigious or not prestigious). We then used the Wilcoxon -Mann-Whitney test after checking the non-normality of the data via the Shapiro-Wilk test.

To verify whether information about medicinal plants from prestigious sources is less prone to cultural mutations than information from less prestigious sources (H2), we created a spreadsheet in which we recorded the names of the individuals and all the cultural traits (plant+part of the plant used in the treatment+disease indicated in the treatment) mentioned by each informant. Next to each piece of information, also treated as a cultural trait, mentioned by individuals, we assigned a value of "1" when the information had undergone mutation or a value of "0" when the information had not undergone mutation. Furthermore, we recorded the transmission mode of cultural traits (prestige bias or other transmission source). Using the binomial family, we then used a generalized linear model (GLM), considering mutation as the dependent variable and the individual's way of learning as the independent variable (prestige bias or another transmission source).

To verify whether prestigious individuals promote more guided variation than cultural mutation (H3), we created a spreadsheet with the names of all individuals recognized as prestigious. Next to each individual's name, we recorded the number of guided variations and also cultural mutation. We then used the Wilcoxon -Mann-Whitney test after checking the data's non-normality via the Shapiro-Wilk test. All analyses were performed in the R development environment.

Results

Of the people interviewed, 28 were cited as individuals recognized as prestigious. Of the prestigious individuals, 16 were female, and 12 were male. All prestigious individuals were aged between 60 and 83 years. 39 medicinal plants cited as being used by individuals in the community were identified (supplementary material). We found a significant difference between the knowledge of people recognized as prestigious and those without prestige, with the knowledge of prestigious people being significantly greater $p < 0.001$ (Table 1). However, we did not find a significant influence of prestige bias on the amount of occurrence of cultural mutations in knowledge about medicinal plants (Table 2). Furthermore, we found a significant difference between the amount of mutation and guided variation in the group of prestigious people, with the amount of guided variation being significantly ($p < 0.022$) greater in this group (Table 3).

Table 1: Wilcoxon -Mann-Whitney test showing the association between knowledge of prestigious and non-prestigious people.

Source of information	Average	Standard deviation	Median	1st Quartile	3rd Quartile	W	p-value
Prestige	25.23	6.63	26	22	28.75	49.5	<0.001
No prestige	7.09	3.67	7	5	9		

Table 2: A generalized linear model with the binomial family shows the association between prestige bias and the occurrence of cultural mutations.

GLM (Hipótese 2)					
Estimate	**Std. Error**	**Z-valor**	**Pr(>|z|)**		**AIC**
Intercept		-2.3585	0.2327 -10.136	<2e-16 ***	542.9
Fonte Prestigio		0.0224	0.3551 0.063	0.95	
Modelo Nulo					
Estimate	**Std. Error**	**Z-valor**	**Pr(>|z|)**		**AIC**
Intercept		-2.3512	0.2009 -11.71	<2e-16 ***	540.9
ANOVA de comparação de modelos					
X^2=0.004; valor de p=0.9497					

Table 3: Wilcoxon -Mann-Whitney test showing the association between the rate of guided variation and cultural mutation of prestigious people.

Type of change	Average	Standard deviation	Median	1st Quartile	3rd Quartile	W	p-value
Mutation	0.55	1	0	0	1	263	<0.022
Guided Variation	1.07	1.02	0	0	two		

Discussion

Do prestigious individuals have more knowledge about medicinal plants than those less prestigious?

The findings of this study confirm the hypothesis that people who are recognized as prestigious have greater knowledge about medicinal plants. Some factors may be contributing to this. One of these factors would be the experience that prestigious individuals have. For example, in this study, we found that individuals recognized as prestigious had a strong history of using medicinal plants, as they have used medicinal plants in different ways for a long time in the community's day-to-day life. Furthermore, they are individuals who have long guided the practice of using medicinal plants for people in the community, whether through the use of isolated medicinal plants or even through the use of more complex preparations, such as vegetable mixtures (bottled, syrups, lickers, etc.) (Dantas et al. 2020, Pereira et al. 2021). In this sense, the set of experiences that individuals from the group of prestigious people have made them highly knowledgeable; these individuals present above-average information compared to other individuals in the community (Jimenéz & Mesoudi, 2020).

It is known that socioeconomic and cultural factors can have a high influence on people's knowledge about medicinal plants, both on a global and local scale (Corroto et al. 2022). Thus, our results regarding prestigious individuals may reflect the influence of some socioeconomic factors. For example, we found that people in the community recognized as prestigious were older (over 60). Thus, we believe that age may be favoring greater knowledge of prestigious people about medicinal plants, as these people have had more time to diversify their experiences with the use of medicinal plants for the treatment of illnesses (Souza et al. 2021), which has already been evidenced in some ethnobotanical studies on local knowledge related to the use of medicinal plants (Nega et al. 2019, Sato 2012, Souza et al. 2022). Furthermore, older people generally have a greater preference for the use of traditional medicine, leading to greater contact with medicinal plants (Sato 2012, Wiryono et al. 2019). In addition, the present study found that people in the prestige group have low incomes. Thus, income is another variable that has contributed to prestigious individuals having greater knowledge about medicinal plants since there is already evidence that income can influence local knowledge about medicinal plants (Alves et al. 2022, Corroto et al. 2022).

Additionally, some evidence indicates that there may be a positive association between prestigious people and their actions in the community (Reyes-Garcia et al. 2008). Perhaps this interaction deserves a new, more careful evaluation, as in this study, we observed that the women recognized as prestigious were mostly faith healers, healers, local leaders, and large cultivators of medicinal gardens. Therefore, the characteristics of their status in the

community may contribute to knowledge about medicinal plants, as already suggested in other studies (Silva et al. 2022, Maciel & Neto 2006) and have a bearing on other people in the community identifying the prestigious people. Furthermore, we observed that most men were recognized as prestigious. In addition to being root healers and healers, they also worked selling medicinal plants or traditional herbal products at local fairs, which favors communication and transmission of information to others. People in the community and this complementary work activity can be an important route for the occurrence of guided variation or cultural mutation.

Another interesting factor to highlight is the fact that many of the prestigious people in the community we studied use only the use of medicinal plants as a therapeutic resource, as during the interviews, they mentioned using only "bush medicines" or "homemade medicines." to cure certain diseases, signaling the existence of a preference for the use of medicinal plants to cure diseases, perhaps because they had learned since childhood from their ancestors, such as parents and grandparents, that the use of medicines extracted directly from plants was better for the treatment of illnesses. Thus, preference may contribute to prestigious people's knowledge of medicinal plants.

Is information about medicinal plants from prestigious sources less prone to cultural mutations than information from less prestigious sources?

The findings of this study lead us to falsify our hypothesis, considering that we found no difference in the occurrence of mutations in the information transmitted by individuals with or without prestige. In general, some studies (Henrich & Gil-White 2001, Jiménez & Mesoudi 2021, Oliveira et al. 2023) show that information acquired from prestigious people may be more likely to be memorable when compared to other sources of information. Thus, we expected that this fact would make information transmitted by prestigious people less susceptible to changes during the process of cultural transmission. However, our findings show that the transmission of information about medicinal plants is susceptible to cultural mutations, even if obtained from people with great knowledge and personal experiences (prestige bias). This may be due to the randomness of cultural mutations (Mesoudi, 2011). In other words, cultural mutations are an unintentional process. They are likely to occur for everyone in the community, as the chances of them occurring are random, regardless of the source of cultural transmission.

One factor contributing to the prestige bias not reducing the chances of cultural mutations occurring is the role that the transmission of information by "vertical route" (transmission from parents to children) plays in the local medical system. For example, evidence from some ethnobiological studies indicates that in local medical systems children's knowledge of medicinal plants often resembles their parents' knowledge more than the knowledge of others in the community (Brito et al. 2019, Santoro et al. 2020). Furthermore, some studies on cultural evolution show that vertical transmission can function as a more conservative route for cultural information compared to information transmitted by other forms of transmission (Hewlett & Cavali-Sforza 1986, Cavalli-Sforza & Feldman 1981). Furthermore, (Dantas et al. 2024) found a lower occurrence of cultural mutations in information transmitted vertically than through oblique and horizontal routes. Thus, in the community we investigated, the prestigious person mentioned by the interviewee did not always represent the father or mother figure. The interviewees may remember more faithfully the information acquired from their parents (perhaps judged as more reliable people) than from information acquired by prestigious individuals other than their parents. It is also important to mention that over time,

human memory systems have evolved, allowing information to be perceived as more relevant from an adaptive point of view and to be better memorized (Nairne & Pandeirada 2008, Nairne et al. 2007). In this sense, for people in the community, information acquired vertically may be perceived as more relevant than information acquired through prestigious sources.

Another factor that may contribute to prestige bias is that it does not reduce the chances of cultural mutations occurring. This may be because people acquire information about medicinal plants through different sources of information at the same time (Dantas et al. 2004). For example, although prestigious people are important to individuals in the community, an individual in the community when needing to acquire information about a plant "X," may turn to a prestigious person, a family member in the community, and also a local friend. Consequently, despite the information being about the same medicinal plant (plant), this can generate confusion information (Arkes 1991) regarding plant X for the individual in the community, which may also contribute to cultural mutations.

The prestige bias may also not contribute to the reduction in cultural mutations due to the variation in information made available by prestigious individuals. Prestigious people generally have diverse experiences and have great knowledge about medicinal plants. Therefore, when transmitting information to another person in the community, a large volume/variation in the information made available can be passed on. Consequently, this large volume/variation of information may be causing "Information Confusion" (Arkes 1991) or a "Causal Mismatch" (Henrich & Mcelreath, 2003), making the minds of individuals who receive information about medicinal plants confusing, thus affecting the memorization of such information. Similarly, there may also be an "incomplete transmission of information" (Eerkens & Lipo, 2005). In other words, due to the variation in information, individuals learning from prestigious people when interacting with others in the community may be passing on information with copy errors. The influence of the large volume of information on the occurrence of cultural mutations is evidenced by some authors, and there is a record that this fact can significantly influence the fidelity of cultural information [38].

Another factor contributing to the prestige bias not resulting in a reduction in the occurrence of cultural mutations is the frequency with which individuals acquire information about medicinal plants from prestigious people compared to acquiring information from other people in the community. For example, due to residential proximity or better local coexistence, when needing to acquire information about medicinal plants, individuals may prefer to turn more frequently to people closer to their homes and who do not have prestige, such as family, friends, or neighbors. Consequently, the frequency with which people in the community acquire information from people closer to them may make it more memorable than information acquired by prestigious people. Therefore, the frequency of information sharing can significantly influence the fidelity of cultural information (Acerbi & Tennie 2016).

The results we found in this study, in a certain way, are similar to the results of some studies that sought to evaluate the influence of prestige bias on the cultural transmission of information. For example, Jiménez & Mesoudi (2020) conducted an experiment on information transmission and investigated whether information attributed to prestigious sources would be culturally transmitted with greater fidelity than information attributed to non-prestigious sources. Contrary to their predictions, the authors did not find a reliable effect of prestige on the fidelity of information transmission. The authors discuss that the scenario they used may have generated a lack of a reliable effect of prestige on people's recall of certain information. As the authors' study was carried out through a transmission chain experiment, the authors suggest that such results may be different from studies that

investigate the influence of prestige bias in everyday life scenarios of local populations. However, our findings are similar to those found by the authors, showing that even in the scenario of human populations, prestige bias may also not influence the occurrence of cultural mutations. Therefore, the empirical results of our study suggest that although prestige bias plays an important role in the scenario of local medical systems, considering the use of medicinal plants, the occurrence of cultural mutations was shown to be a completely random process, as suggested in cultural evolution (Mesoudi 2011).

The present study's findings contribute to an increase in studies carried out on cultural mutations in the scenario of human populations and strengthen the need for new developments. For example, our data complements evidence from (Dantas et al. 2020, Pereira et al. 2021, Dantas et al. 2024) on cultural mutations in local medical systems. The authors provide evidence of factors that can influence the accumulation of cultural mutations. In turn, the authors indicate prestige bias as an important factor that would need to be investigated in future studies on cultural mutations, suggesting that prestige bias could have an important role in controlling cultural mutations in medicinal plants. However, our results showed that in the Lagoa do Junco community; prestige bias was not a factor that contributed to reducing the emergence of cultural mutations in the local medical system, but points to the need to evaluate communities immersed in other social-ecological systems to confirm the fact that mutations occur randomly, as detected in this research.

Do prestigious individuals promote more guided variation than cultural mutation?

Our results confirm the hypothesis that people recognized as prestigious generate more guided variation than cultural mutation. This occurred because prestigious individuals have vast knowledge and diverse personal experiences in the Lagoa do Junco community. This fact has already been highlighted in other studies on human groups (Henrich & Gil-White 2001, Jiménez & Mesoudi 2020). Having high knowledge makes the informant more able to change information intentionally without the changed information losing its meaning/effect. Furthermore, the extensive knowledge and experience that prestigious individuals have with medicinal plants may be contributing to such individuals having a good recall of cultural information, generating low cultural mutation.

Another factor contributing to prestigious people generating more guided variation than cultural mutation is that many of the prestigious individuals are local farmers and market traders and work in producing and commercializing medicinal preparations, such as lickers, bottles, and medicinal syrups (Dantas et al. 2020). Because of this, prestigious people intentionally change information to make using plants and medicinal preparations more attractive to community members. For example, a prestigious individual may have learned information about the bark of a plant from a person in the community. However, the individual who received the information, intentionally and preferentially, can use the leaves of a plant for medicinal licker, giving rise to a guided variation. Changes of this type may occur in using other plants to prepare other types of medicinal preparations, increasing the amount of guided variation in the local medical system.

|In addition, it is possible that the amount of guided variation is greater than the number of cultural mutations in the group of prestigious people due to social factors, such as the age and education of prestigious people, as in the community we investigated Prestigious people were older and had less education. Such factors may contribute to the increase in guided variation, as other studies have shown that older age associated with lower education

generates fewer cultural mutations in local medical systems (Pereira et al. 2021).

Conclusions

This study shows that prestige bias plays an important role in the knowledge and dynamics of cultural transmission about medicinal plants in local medical systems. In addition, it highlights the occurrence of cultural mutation and guided variation in knowledge about medicinal plants in the structuring of local medical systems.

Despite the importance of prestige bias in cultural transmission, our findings demonstrate that in local medical systems, learning from prestigious people is not a factor that reduces the emergence of cultural mutations, contradicting evidence suggested in previous studies. Furthermore, this study showed that experience and extensive knowledge of medicinal plants may be associated with the emergence of guided variation in the context of human cultures. Thus, it is clear that prestige bias is a factor that, by generating cultural mutation or guided variation, directly influences the dynamics of cultural evolution in local medical systems.

Although most studies on cultural mutations are based on local knowledge about medicinal plants for treating human illnesses, we noticed that people from the Lagoa do Junco community also use medicinal plants to treat domestic animals or medicinal products of animal origin for the treatment of illnesses. Therefore, we suggest that future studies evaluate the role of the prestige pathway and other pathways in inducing cultural mutations and guided variations, also considering the use of medicinal animals or plants to treat animal diseases. Considering that the social-ecological context in which human populations are inserted is relevant in inducing cultural mutations and guided variations, we indicate the need to expand the number of studies to cover different social-ecological contexts aiming for greater generalizations about the role of these phenomena in systems local doctors.

Limitations

Studies carried out on cultural mutations and guided variation in the scenario of human populations, considering the use of medicinal plants in local medical systems, are still pioneering. There are only three previous studies (Dantas et al. 2020, Pereira et al. 2021, Dantas et al. 2024). The only methodology used to collect data has been semi-structured interviews. However, as the investigation of cultural mutations and guided variations depends greatly on the recall of information from participating individuals, there is a limitation related to memory, as the interviewee may not remember the person from whom he acquired knowledge about the medicinal plant used while carrying out the interview. Also, during the interviews, the apprentice individual may have mentioned that he uses a certain plant to cure an illness different from that indicated by the transmitting individual due to the fact that it is versatile, not considering all medicinal indications of the versatile species. Therefore, due to the informant's limited memory, we suggest that new studies include new methods or questions to minimize such limitations' effect.

Furthermore, the existence of methods that differentiate the occurrence of cultural mutations from the occurrence of guided variations in the scenario of human populations is still something that studies in cultural evolution have not evidenced. In an embryonic way, we also used semi-structured interviews to differentiate the occurrence of these processes in local knowledge. However, it is important to develop other methods that can be used to differentiate the occurrence of these phenomena and reduce the risk of bias.

Statements

List of abbreviations:
EC: Cultural evolution.
IBGE: Brazilian Institute of Geography and Statistics.
TCLE: Informed consent form.
GLM: Generalized linear model.
IPA: Agronomic Research Institute of Pernambuco.
CEP: Research Ethics Committee.
SISGEN: National System for Management of Genetic Heritage and Associated Traditional Knowledge

Ethical Approval and Participant Consent:
Ethical recommendations for research with human beings were met. We had approval from the Research Ethics Committee of the University of Pernambuco-UPE CAAE: 97380918.9.0000.5207. We also registered our research with the National System for Management of Genetic Heritage and Associated Traditional Knowledge-SISGEN. We use the Free and Informed Consent Form (TCLE) for people to express their consent to participate in the present work.

Consent for Publication:

Not applicable.

Availability of Data and Materials:
The data generated by this study are available upon request.

Competing interests:
The authors declare no conflicts of interest.

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Author Contributions:
Janilo Italo Melo Dantas conducted the fieldwork, statistical analysis, and manuscript writing. André Luiz Borba do Nascimento contributed to the statistical analysis and manuscript writing. Taline Cristina da Silva contributed to the writing of the manuscript. Ulysses Paulino Albuquerque and Elcida de Lima Araújo participated in the study's conception, analysis, and manuscript writing.

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CAPÍTULO IV

A INFLUÊNCIA DE MUTAÇÕES CULTURAIS NO ESTABELECIMENTO DE TRAÇOS BIOCULTURAIS MAL ADAPTADOS EM SISTEMAS MÉDICOS LOCAIS

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A INFLUÊNCIA DE MUTAÇÕES CULTURAIS NO ESTABELECIMENTO DE TRAÇOS BIOCULTURAIS MAL ADAPTADOS EM SISTEMAS MÉDICOS LOCAIS

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Resumo

***Relevância Etnofarmacológica*:** À luz da Teoria da Evolução Cultural-EC (Campo teórico que busca explicar como a cultura evolui ao longo do tempo), este estudo apresenta informações sobre tratamentos eficientes e ineficientes de plantas medicinais utilizadas em sistemas médicos locais.

Objetivo do estudo: De acordo com o campo teórico da Evolução Cultural (EC) as informações transmitidas culturalmente podem sofrer mudanças aleatórias, processo denominado como "Mutações Culturais". Esses processos podem afetar as culturas humanas, como por exemplo, contribuir para o estabelecimento de "Traços Bioculturais Mal Adaptados" (comportamentos adotados que não desempenham benefícios para a sobrevivência dos seres humanos). No cenário dos sistemas médicos locais esses comportamentos podem ser representados por plantas utilizadas para fins medicinais mas que não possuem a eficiência medicinal desejada. Neste estudo, nós buscamos investigar a influência das mutações culturais no estabelecimento de traços bioculturais mal adaptados em sistemas médicos locais. Testamos à seguinte hipótese: H1:informações sobre plantas medicinais com mutações culturais geram uma maior quantidade de traços bioculturais mal adaptados em sistemas médicos locais.

***Materiais e Métodos**:* Para testar nossa hipótese nós utilizamos o cenário da comunidade Lagoa do Junco. Comunidade rural localizada no município de Santana do Ipanema, no sertão do estado de Alagoas. Os dados sobre mutações culturais foram coletados através de entrevistas semiestruturadas com 120 indivíduos maiores de 18 anos da comunidade. Para verificar a ocorrência de traços bioculturais mal adaptados, realizamos uma revisão bibliográfica da literatura farmacológica para classificar tratamentos eficientes e ineficientes a partir das informações do conhecimento local sobre plantas medicinais. Os dados foram analisados através de uma regressão linear simples através software BioEstat versão 5.3.

Resultados: Ao contrário das nossas previsões não encontramos uma relação significativa entre informações sobre plantas medicinais com mutações culturais e uma maior ocorrência de traços bioculturais mal adaptados (F=0,98; p=0,64).
Conclusões: Esperamos que os resultados deste estudo proporcionem maiores compreensões sobre o estabelecimento de comportamentos culturais mal adaptados no cenário dos sistemas médicos locais.

Palavras-Chave: Etnobotânica; Evolução Cultural; Transmissão Cultural; Erros de Cópia; Má Adaptação

1.0. INTRODUÇÃO

Os sistemas médicos locais tratam-se de um dos principais sistemas que foram desenvolvidos pelos seres humanos para curar a existência dos problemas de saúde (Dunn, 1976). Nesses sistemas circulam diversas informações que as pessoas adotam para curar enfermidades. Por sua vez, as informações que circulam nesses sistemas são denominadas como "Traços Bioculturais" (Albuquerque et al. 2020). Um grande exemplo dos traços bioculturais nos sistemas médicos locais são as informações sobre plantas medicinais (Santoro et al. 2018; Dantas et al. 2020; Pereira et al. 2021).

A transmissão dos traços bioculturais como as informações sobre plantas medicinais desempenham um papel importante para os sistemas médicos locais, tendo em vista que funcionam como uma importante alternativa para as pessoas curarem doenças (Albuquerque et al. 2020; Santoro et al. 2020). Porém, apesar da importância da transmissão de traços bioculturais nos sistemas médicos locais, de acordo com o campo teórico da "Evolução Cultural" (EC), nem todas informações que circulam nos sistemas de diferentes culturas humanas desempenham benefícios para a sobrevivência das pessoas (Mesoudi, 2011).

O campo da Evolução Cultural (EC), trata-se de um importante arcabouço teórico que busca explicar como a cultura evolui ao longo do tempo (Mesoudi, 2011; Santoro et al. 2018). De acordo com esse campo teórico, para que ocorra a evolução cultural a transmissão de informações culturais é um fator essencial. Contudo, de acordo com a EC a transmissão de informações culturais pode contribuir para disseminação de "Traços Mal Adaptados" (Mesoudi, 2011). Os traços mal adaptados são definidos pela EC como comportamentos adotados que não contribuem positivamente para as culturas humanas (Mesoudi, 2011). Esses traços podem ser exemplificados pelos tratamentos que as pessoas utilizam para curar enfermidades, mas que não apresentam a eficácia de cura esperada (Tanaka et al. 2009; Santoro et al. 2018). Nos sistemas médicos locais, os traços culturais mal adaptados são denominados como "Traços Bioculturais Mal Adaptados" (Albuquerque et al. 2020) e podem ser exemplificados pelas plantas que as pessoas utilizam como medicinal mas que não possuem a eficácia farmacológica esperada (Tanaka et al. 2009; Dantas et al. 2020). É importante mencionar que além da

eficiência farmacológica ou química das plantas medicinais, a cura é um fator multifatorial que pode ser moldado por outros fatores como psicológicos, espirituais e religiosos (Dias & Santori, 2015; Ferreira et al. 2021; Oliveira, 2018). Entretanto, consideramos que os traços bioculturais mal adaptados podem ser representados por plantas que as pessoas utilizam como medicinal mas que não possuem a eficácia farmacológica esperada porquê a eficiência farmacológica de plantas medicinais é considerado como um dos fatores essenciais para a efetivação de cura de enfermidades humanas. Além disso, tem sido a eficiência de cura mais divulgada cientificamente.

Atualmente, existem alguns fatores que estão relacionados ao estabelecimento de traços bioculturais mal adaptados. Entre alguns dos principais fatores destaca-se a ocorrência de "Mutações Culturais" (Dantas et al. 2020; Santoro et al. 2018; Dantas et al. 2024). As mutações culturais são definidas como uma alteração aleatória da informação (Mesoudi, 2011). Essas alterações ocorrem através da troca de informações culturais entre os indivíduos a maneira em que as informações são transmitidas de uma pessoa para outra (Mesoudi, 2011; Dantas et al. 2024). Geralmente as mutações culturais ocorrem porque a cópia de determinadas informações não ocorre de forma idêntica entre a pessoa que transmite e a pessoa que aprende a informação (Dantas et al. 2020). Uma das razões para isso seria porque algumas vezes, a mente humana pode não armazenar identicamente determinadas informações (Baravalle, 2012). Estudos recentes confirmaram a existência das mutações culturais em sistemas médicos locais sobre o conhecimento de plantas medicinais (Dantas et al. 2020; Pereira et al. 2014; Dantas et al. 2024). Consequentemente, essa ocorrência de mutações culturais nos sistemas médicos locais pode está contribuindo para o estabelecimento de traços bioculturais mal adaptados, pois, durante a transmissão cultural, se as informações sobre plantas medicinais que são eficazes são alteradas, essa alteração da informação pode levar o estabelecimento de tratamentos ineficientes para as culturas humanas (Santoro et al. 2018; Dantas et al. 2024).

Crescentemente vários estudos na evolução cultural tem evidenciado a existência e as implicações dos traços mal adaptados para as culturas humanas (Tanaka et al. 2009; Baravalle 2012, Tanaka et al. 2018; Santoro et al. 2018). Entretanto, muitos dos estudos tratam-se de referências teóricas ou que foram realizados baseados em experimentos laboratoriais e fora do contexto dos sistemas médicos locais, sendo ainda obscuro os fatores que estão envolvidos no estabelecimento de traços bioculturais mal adaptados nos sistemas médicos locais. Além disso, apesar de estudos recentes confirmarem a existência de mutações culturais em sistemas médicos locais sobre o conhecimento de plantas medicinais (Dantas et al. 2020; Pereira et al. 2014; Dantas et al. 2024), não se sabe sobre como a ocorrência desses fenômenos tem operado sobre o surgimento de traços bioculturais mal adaptados nos sistemas médicos locais. Assim, tendo em vista que a ocorrência de mutações culturais é evidenciado pelo campo da evolução cultural como um dos principais fatores que podem contribuir

para o estabelecimento de traços culturais mal adaptados (Mesoudi 2011; Santoro et al. 2018), neste estudo nós buscamos investigar a influência da ocorrência de mutações culturais sobre o estabelecimento de traços bioculturais mal adaptados em sistemas médicos locais. Para isso, nós buscamos testar a seguinte hipótese: H1:informações sobre plantas medicinais com mutações culturais geram uma maior quantidade de traços bioculturais mal adaptados em sistemas médicos locais. Nossa expectativa é de que haverá maior proporção de traços bioculturais mal adaptados para plantas que sofreram mutação do que para plantas que não sofreram.

2.0. Material e Métodos

2.1. Área de Estudo

Como área de estudo nós utilizamos o cenário de um sistema médico local da região do alto Sertão de Alagoas, Nordeste do Brasil. Esse sistema médico local foi o da comunidade "Lagoa do Junco", localizado no município de Santana do Ipanema no estado de Alagoas, distando cerca de 107 km da capital do estado (Maceió) (IBGE, 2021). A Comunidade "Lagoa do Junco", está situada em um ambiente caatinga, apresenta um total de 83 famílias cadastradas, totalizando em média 188 indivíduos residentes.

A Lagoa do Junco é uma comunidade que apresenta bastante prestígio pelo município de Santana do Ipanema e pode ser considerada como uma das principais comunidades do município. Nela é possível encontrar estabelecimentos educacionais, hospitalar, comerciais e religiosos. As pessoas da comunidade Lagoa do Junco obtém sua renda principalmente através de atividades relacionadas a agricultura de subsistência e também através de empregos formais e não formais do município de Santana do Ipanema e de outros municípios vizinhos. As pessoas da comunidade costumam realizar ações extrativistas, seja em uma mata local que está localizada próximo da comunidade e também em outras áreas florestais de sítios e comunidades vizinhas. O uso de plantas medicinais é uma prática cultural bastante frequente pelos indivíduos da comunidade e a mesma vem sendo utilizada como um importante cenário de estudos etnobiológicos na região (Dantas et al. 2020; Pereira et al. 2021; Dantas et al. 2024).

2.2. Aspectos Éticos e Legais

Para a realização deste estudo cumprimos as instruções da Resolução (466/12) do Conselho Nacional de Saúde para pesquisas com seres humanos. O trabalho teve aprovação do Comitê de Ética em Pesquisa (CEP) da Universidade de Pernambuco-UPE, CAAE: 97380918.9.0000.5207. Para que as pessoas participassem deste estudo nós também respeitamos o consentimento das mesmas. Para isso, nós esclarecemos a realização do nosso estudo para as pessoas da comunidade e aqueles

indivíduos que aceitaram corroborar como os dados da nossa pesquisa foram convidados a assinarem o termo de Consentimento Livre e Esclarecido (TCLE). Como a comunidade que investigamos está situada fora do contexto de Unidades de Conservação, nós utilizamos o comprovante de registro do Sistema de Informação e Autorização da Biodiversidade (SISBIO) sob o número: 64841-1. Além disso, registramos nossa pesquisa no Sistema Nacional de Gestão do Patrimônio Genético e do Conhecimento Tradicional Associado-SISGEN (número AB5C935).

2.3. Coleta de Dados

2.4. Dados Sobre Mutações Culturais

Para a coleta de dados sobre mutações culturais, nós utilizamos o mesmo procedimento metodológico de Dantas et al. (2020) e Dantas et al. (2024). Por exemplo, os dados sobre mutações culturais foram coletados em duas etapas (Dantas et al. 2020; Dantas et al. 2024). Na primeira etapa, inicialmente foi utilizado a técnica de Listagem Livre (Albuquerque et al. 2014) para acessar a lista de plantas medicinais conhecidas pelas pessoas. Após essa técnica foram realizadas Entrevistas Semiestruturadas (Albuquerque et al. 2014), com o intuito de acessar informações sobre as plantas que foram listadas pelos indivíduos. Por exemplo, durante a realização das entrevistas semiestruturadas foram feitos os seguintes questionamentos: 1) Para qual/quais doenças ou enfermidades essa planta é indicada? 2) Qual parte/partes da planta é utilizada no tratamento? 3) Com quem você obteve esse conhecimento?. A realização das entrevistas semiestruturadas além de possibilitar o acesso as informações sobre plantas medicinais utilizadas pelas pessoas, possibilitou também que fossem identificados os indivíduos transmissores (pessoa que transmitiu a informação no sistema médico local) e indivíduos aprendizes (pessoa que aprendeu a informação no sistema médico local) (Dantas et al. 2020).

Após a realização das entrevistas semiestruturadas, foram analisadas e comparadas as informações/traços bioculturais dos indivíduos transmissores com as informações/traços bioculturais dos indivíduos aprendizes do sistema médico local, a fim de identificar possíveis casos de mutações culturais entre o conhecimento local (Dantas et al. 2020). Nessa análise, foi levado em consideração as informações a respeito de uma mesma planta que foi utilizada pelo indivíduo transmissor e também pelo indivíduo aprendiz da informação, sendo considerado mutação quando: 1 - o alvo terapêutico (doença), indicado por um indivíduo aprendiz foi diferente do indicado pelo indivíduo transmissor da informação; 2- quando a parte da planta utilizada pelo aprendiz, foi diferente do indivíduo transmissor da informação (Dantas et al. 2020).

Na segunda etapa da coleta de dados, tendo em vista que as pessoas podem alterar as informações de forma aleatória (mutação cultural) e de forma intencional (Variação Guiada) (Mesoudi,

2011), para a certeza de que as possíveis alterações nas informações entre indivíduos eram realmente não intencionais (mutação), em um outro período distinto, foi realizada uma nova etapa de coleta dados. Essa etapa foi composta pela realização de novas entrevistas semiestruturadas. Porém, se restringiu apenas aos indivíduos aprendizes e indivíduos transmissores do sistema médico local, que apresentaram possíveis casos de mutação em suas informações. Para realização dessa etapa, cada indivíduo aprendiz e transmissor de informação do sistema médico local, foi notificado de suas informações que haviam sido mencionadas pelos mesmos durante a realização das entrevistas na primeira etapa da coleta de dados. Em seguida, após serem notificados, foram realizados alguns questionamentos indutivos. Por exemplo: 1) dias atrás (primeira etapa) você mencionou que usa a planta X para curar a doença Y. Porém, essa planta também pode ser usada para curar outro tipo de doença? Se sim, qual? 2) Você já usou essa planta para curar outra doença no passado? Se sim, qual? 3) Você já indicou esse tipo de planta para alguém, para curar outro tipo de doença que não seja essa? Se sim, qual? 4) Dias atrás você mencionou que usa a parte X dessa planta. No entanto, outras partes da planta também podem ser usadas? Se sim, qual? A partir desses questionamentos, foi possível verificar se as mudanças nas informações que ocorreram no sistema médico entre os indivíduos transmissores e indivíduos aprendizes foram aleatórias (mutação cultural) ou se foram intencionais (variação guiada).

2.5. Coleta e Identificação das Plantas

Para a coleta do material botânico, optamos por utilizar a técnica Turnê-Guiada (Albuquerque et al. 2014), na qual, no final de cada entrevista, os informantes foram convidados a indicar as plantas medicinais que estavam dentro ou próximas de suas propriedades. Com isso, coletamos espécimes com seus materiais reprodutivos e foram coletadas cerca de 39 espécies vegetais. As espécies coletadas foram identificadas por especialistas botânicos e todas as exsicatas encontram-se depositadas no Instituto de Pesquisa Agronômica de Pernambuco-IPA.

2.6. Classificação de Tratamentos Eficientes e Ineficientes (traços bioculturais mal adaptados)

Para verificar os tratamentos eficientes e ineficientes das plantas utilizadas como medicinais, nós realizamos uma revisão bibliográfica da literatura farmacológica. Para isso, nós buscamos estudos que realizaram testes farmacológicos com as plantas medicinais que foram citadas pelos informantes da comunidade. Para a busca dos trabalhos, nós utilizamos ás seguintes plataformas de buscas: Pubmed (http://www.ncbi.nlm.nih.gov/pubmed), ScienceDirect (http://www.sciencedirect.com); Scopus (http://www.scopus.com); e Web of Science (http://appswebofknowledge.ez19.periodicos.capes.gov.br/). Essas plataformas foram escolhidas por

devido envolverem uma grande amplitude de estudos na área medicinal e farmacológica (Nascimento et al. 2017). Para busca dos trabalhos nas plataformas, nós utilizamos como palavras-chave o nome científico da espécie de planta, acompanhada pela parte da planta utilizada e suas possíveis funções farmacológicas conforme foram citadas pelos informantes da comunidade. Além da revisão bibliográfica da literatura farmacológica nós contamos com apoio do banco de dados de Nascimento (2017). Esse banco de dados contém uma lista de plantas medicinais que foram testadas farmacologicamente por estudos realizados até o ano de 2017. Essas informações do banco de dados foram coletadas por meio de uma revisão sistemática realizada pelo autor. Dessa forma, nós utilizamos esse banco de dados para verificar se o mesmo apresentava informações farmacológicas sobre algumas das plantas medicinais do nosso estudo.

Para auxiliar na classificação dos tratamentos ineficientes ou eficientes, as informações das plantas medicinais mencionadas pelos entrevistados foram separadas por "Unidades de Informação". Unidades de informação (UI), se refere a associação entre uma planta + doença ou agravo que a determinada planta é indicada + parte da planta utilizada para a cura da doença ou agravo indicado (Santoro et al. 2015). Por exemplo, "*Aloe vera* (L.) Burm. f.– dor de cabeça- folha", "*Mentha villosa* Huds. - gripe- folha", "*Psidium guajava* L.– gastrite - casca", são exemplos de três unidades de informação distintas entre si. A partir da revisão bibliográfica da literatura farmacológica, consideraremos como um tratamento ineficiente (traços bioculturais mal adaptados), as unidades de informações de plantas medicinais que não apresentaram a atividade farmacológica esperada.

2.7. Critérios de seleção dos dados

Mediante a busca pelos trabalhos, nós consideramos os estudos que estavam disponíveis online antes de abriu de 2024 e que tivessem realizados testes farmacológicos das plantas medicinais. Nós desconsideramos: 1) estudos que apenas registram o uso de plantas medicinais por populações humanas locais; 2) estudos que apenas descreveram os compostos fitoquímicos das plantas medicinais; 3) estudos que não mostraram o efeito individual da planta; 4) estudos que não foram acessíveis online; 5) estudos de revisão bibliográfica que apenas mencionaram o efeito da planta e 6) estudos que mencionem apenas as vias metabólicas ligadas ao mecanismo de ação de compostos isolados a partir das plantas.

2.8. Análise de Dados

Para verificar se informações locais sobre plantas medicinais com mutações culturais geram uma maior quantidade de traços bioculturais mal adaptados, criamos uma planilha na qual registramos todas as plantas mencionadas pelos informantes. Em outra coluna atribuímos o número de vezes que

houve mutação cultural para cada espécie (por exemplo: “1” para uma mutação associada a uma espécie e “2” para duas mutações associadas a uma espécie). Além disso, em outra coluna atribuímos o número de vezes que houve traço biocultural mal adaptado para cada espécie. (por exemplo: “1” para um traço biocultural mal adaptado associado a uma espécie e “2” para dois traços bioculturais mal adaptados associadas a uma espécie e assim por diante). Em seguida, nós utilizamos uma regressão linear simples no software BioEstat versão 5.3, considerando como variável independente o número de mutação cultural de cada espécie e como variável dependente o número de traços bioculturais mal adaptados associado a cada espécie.

3.0. RESULTADOS

Os dados do nosso estudo indicaram que não existe uma relação significativa entre informações sobre plantas medicinais com mutações culturais e a ocorrência de traços bioculturais mal adaptados ($F=0,98$; $p=0,64$). Um total de 158 unidades de informação foram citadas pelas pessoas da comunidade Lagoa do Junco. Das unidades citadas, apenas 53 foram estudadas farmacologicamente, e destas 47 unidades de informação foram eficientes para o tratamento da enfermidade e 06 foram ineficientes. As unidades de informação e os estudos farmacológicos podem ser vistos na tabela 1.0 no material suplementar.

4.0. DISCUSSÃO

De forma geral, a teoria da evolução cultural evidencia a ocorrência de mutações culturais como um dos principais fatores que podem contribuir para o estabelecimento de traços mal adaptados (Mesoudi, 2011), pois a existência de mutações culturais nos sistemas médicos locais pode aumentar a possibilidade da ocorrência de traços bioculturais mal adaptados (Santoro et al. 2018; Dantas et al. 2020; Dantas et al. 2024). Devido á isso, nós esperávamos que as informações sobre plantas medicinais com mutações culturais estivessem gerando uma maior quantidade de traços bioculturais mal adaptados. Porém, os dados do nosso estudo mostraram não existir uma relação entre o número de mutações culturais associados as plantas medicinais e a quantidade de traços bioculturais mal adaptados, indicando que mutações culturais necessariamente não resulta em traços bioculturais mal adaptados nos sistemas médicos.

A falta de relação entre mutações culturais e traços culturais mal adaptados nos leva a sugerir que a ocorrência de mutações culturais e de traços bioculturais mal adaptados sejam processos que possam ocorrer de forma independente. Detectamos no presente estudo que algumas plantas medicinais com mutações culturais não levaram o estabelecimento de traços bioculturais mal adaptados, assim como, algumas plantas medicinais com traços bioculturais mal adaptados não

apresentaram nenhuma mutação cultural. Isso demonstra que a ocorrência de mutações culturais e de traços bioculturais mal adaptados nos sistemas médicos locais possa ser algo aleatório e que a explicação dos fenômenos que estão envolvidos na ocorrência desses processos é algo que precisa continuar a ser investigado por mais estudos na evolução cultural.

Adicionalmente, embora os dados do nosso estudo confirmem a presença de traços bioculturais mal adaptados no conhecimento sobre plantas medicinais, seguindo o registrado em outros estudos (Dantas et al. 2020; Pereira et al. 2021; Dantas et al. 2024), a ocorrência de mutações culturais no conhecimento local pode está desempenhando implicações mais positivas ou neutras do que negativas. Acreditamos que isso esteja ocorrendo porque os estudos farmacológicos apoiaram a maioria dos usos das plantas medicinais relatados pelos indivíduos da comunidade na mutação identificada. Dessa forma, também acreditamos que seja essencial o desenvolvimento de mais estudos que investiguem as implicações das mutações culturais no conhecimento sobre plantas dos sistemas médicos locais, pois isso pode ser importante para compreender a generalização dos efeitos das mutações culturais para as culturas humanas.

Um fator importante a ser mencionado é que o fato de termos encontramos uma grande quantidade de estudos farmacológicos que apoiam a maioria dos usos das plantas medicinais relatados pelos indivíduos da comunidade, sugere que no contexto que investigamos, o sistema médico local pode está sendo uma estratégia adaptativa eficaz, desempenhando um papel fundamental para a cura de doenças dos indivíduos. Assim, isso é extremamente importante, pois esses resultados realçam as previsões do quanto o conhecimento popular sobre plantas medicinais de comunidades locais pode ser eficaz para o desenvolvimento de fármacos e outras estratégias de cura de doenças (Gadelha et al. 2013; Albuquerque & Hanazaki, 2006).

Um outro fator que nos chamou atenção foi que existe uma grande quantidade de estudos que evidenciam a eficiência farmacológica de plantas medicinais. Por outro lado, existe uma baixa quantidade de estudos voltados para evidenciar a ineficácia farmacológica de plantas medicinais. Por sua vez, isso apresenta uma relação sobre o que é evidenciado por De Barra et al. (2017). Os autores evidenciam em seu estudo que informações de tratamentos eficazes costumam serem mais divulgadas do que informações de tratamentos ineficazes pela literatura médica. Além disso, De Barra et al. (2014) inferem que informações de tratamentos eficazes e que desempenham resultados positivos, são mais propensos de se espalhar do que informações de tratamentos ineficazes, pois, as pessoas geralmente tendem a compartilhar mais sucessos do que fracassos. Dessa forma, isso sugere que embora existam tratamentos ineficientes pela comunidade que investigamos, muitos desses usos não puderam ser identificados pela falta da existência de trabalhos que evidenciassem a ineficácia de tais plantas medicinais. Consequentemente, o fato das informações sobre tratamentos eficazes serem mais

divulgados do que tratamentos ineficazes (De Barra et al. 2017; De Barra et al. 2014) pode ser uma fator chave para que traços culturais mal adaptados permaneçam sendo utilizados em populações humanas. Isso acontece porque por mais que as pessoas utilizem tratamentos ineficaz, a falta de evidências sobre a ineficácia de tais tratamentos pode ser um fator chave para que tais tratamentos continuem sendo mantidos e utilizados pelas pessoas.

5.0. CONCLUSÕES

A realização deste estudo realça a ocorrência de traços bioculturais mal adaptados no cenário de populações humanas, especificamente nos sistemas médicos locais conforme indicado em alguns estudos sobre a evolução cultural. Aliado a isso, nossos dados também inferem que o uso de plantas para fins medicinais pode levar a adoção de comportamentos mal adaptados, porém a ocorrência de mutações culturais não é necessariamente um fator que resulte no estabelecimento de traços bioculturais mal adaptados nos sistemas médicos locais. Este estudo indica que ainda temos muito a investigar para compreender porque as pessoas adotam comportamentos culturais mal adaptados. No caso da comunidade Lagoa do Junco, mutação cultural não teve relação linear crescente com traços culturais mal adaptados. Todavia, não podemos fazer generalizações com base em um único estudo, pois não sabemos se em outros sistemas socioecológicos a relação mutação cultural-traço biocultural mal adaptado poderá existir, o que precisa ser investigado para melhor avaliarmos as implicações das mutações culturais nos sistemas médicos locais.

6.0. LIMITAÇÕES

A realização do nosso estudo possui algumas limitações metodológicas. Por exemplo, a realização de entrevistas semiestruturadas tem sido a única metodologia utilizada para coleta de dados de mutações culturais em sistemas médicos (Dantas et al. 2020; Pereira et al. 2021; Dantas et al. 2024). Por sua vez, como a coleta de mutações culturais exige muito da memória do informante, durante a realização das entrevistas semiestruturadas, ao serem questionados sobre com quem aprenderam determinadas informações, os indivíduos podem não ter se recordado com precisão sobre com quem de fato aprenderam determinadas informações culturais. Semelhantemente, durante realização das entrevistas semiestruturadas o indivíduo aprendiz pode ter mencionado que utiliza uma determinada planta para curar uma doença diferente da indicada pelo indivíduo transmissor devido a determinada planta ser versátil. Com isso, devido a limitações relacionadas a memória o mesmo pode não ter se recordado com precisão de todas indicações medicinais associadas a espécie versátil. Dessa forma, é importante que próximos estudos sobre mutações culturais considerem essas limitações.

Um fator importante a ser mencionado é que o uso de entrevistas semiestruturadas, apesar de

ser um dos principais métodos etnobiológicos utilizados para acessar o conhecimento local, o uso desse método para diferenciar mutação cultural de variação guiada pode gerar ruídos. Nesse sentido, pensamos que seja importante no campo da etnobiologia evolutiva e da evolução cultural o desenvolvimento de métodos que possam aprimorar a coleta de dados sobre mutações culturais e variações guiadas no cenário de populações humanas.

Neste estudo a classificação os traços bioculturais como mal adaptados ou adaptados dependeu da realização de estudos farmacológicos disponíveis que testasse a eficiência farmacológica da planta medicinal, mas não conseguimos encontrar estudos que tivessem testado farmacologicamente todas a unidades de informação sobre as plantas medicinais do nosso banco de dados. Consequentemente, isso impossibilitou a classificação de alguns traços bioculturais (se eram de fato mal adaptado ou adaptado). Dessa forma, é importante que próximos estudos sobre traços bioculturais mal adaptados considerem essa limitação.

7.0. Declaração de contribuição de autoria

Janilo Dantas: Conduziu o trabalho de campo, análise estatística e redação do manuscrito. **André Nascimento:** contribuiu na análise estatística e redação do manuscrito. **Taline Silva:** contribuiu na redação do manuscrito. **Ulysses Albuquerque:** participou da concepção, análise e redação do estudo**. Elcida Araújo:** participou da concepção, análise e redação do estudo.

7.1. Declaração de interesse concorrente

Os autores declaram que não têm interesses financeiros concorrentes ou relações pessoais conhecidas que possam ter influenciado o trabalho relatado neste artigo.

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Tabela 1. Unidades de informação associadas as plantas medicinais da Comunidade Lagoa do Junco, município de Santana do Ipanema, Alagoas e que foram estudadas por estudos farmacológicos.

Espécie	Doença	Parte da Planta Utilizada	Eficiente	Não Eficiente	Autor
Aloe vera (L.) Burm. f.	diarreia	folhas	x		Kedarnath et al. 2013
Aloe vera (L.) Burm. f.	pneumonia	folhas	x		Kedarnath et al. 2013
Aloe vera (L.) Burm.f.	Inflamação	folhas	x		Vijayalakshmi et al. 2012
Aloe vera (L.) Burm.f.	Inflamação	folhas	x		Vázquez et al.1996
Aloe vera (L.) Burm.f.	Inflamação	folhas	x		Reuter et al. 2008
Aloe vera (L.) Burm.f.	Inflamação	folhas	x		Paul et al. 2017
Aloe vera (L.) Burm. f.	gastrite	folhas	x		Park et al. 2017
Anadenanthera colubrina (Vell.) Brenan	dor	folhas	x		Santos et al. 2013
Anadenanthera colubrina (Vell.) Brenan	inflamação	folhas	x		Santos et al. 2013
Capsicum frutescens L.	Tumores	Não informado	x		Aniowati et al. 2021
Citrus x aurantium L.	ansiedade	folhas	x		Oliveira et al.2023
Citrus x aurantium L.	gripe	cascas	x		Fadilah et al. 2022
Commiphora leptophloeos (Mart.) J.B.Gillett	diarreia	folhas	x		Pessoa et al. 2021
Cymbopogon citratus (DC.) Stapf	febre	folhas	x		Gbenou et al. 2013
Cymbopogon citratus (DC.) Stapf	febre	folhas	x		Tarkang et al. 2015
Cymbopogon citratus (DC.) Stapf	insônia	folhas	x		Costa et al. 2011
Cymbopogon citratus (DC.) Stapf	diarreia	folhas	x		Shin 2005

Cymbopogon citratus (DC.) Stapf	diarreia	folhas	x		Raybaudi-massilia et al. 2006
Cymbopogon citratus (DC.) Stapf	diarreia	folhas	x		Devi et al. 2011
Eugenia pitanga L.	diarreia	folhas		x	Pinto et al.
Erythrina velutina Willd.	insônia	folhas	x		Raupp et al. 2008
Erythrina velutina Willd.	insônia	folhas	x		Dantas et al. 2004
Erythrina velutina Willd.	insônia	folhas	x		Ribeiro et al. 2006
Erythrina velutina Willd.	insônia	folhas	x		Carvalho et al. 2009
Erythrina velutina Willd.	inflamação	folhas	x		Vasconcelos et al. 2011
Erythrina velutina Willd.	infecção intestinal	folhas		x	Almeida et al. 1995
Harrisia adscendens (Gürke) Britton & Rose	diarreia	folhas	x		Santos et al. 2018
Hibiscus rosa-sinensis L.	ferimentos	flores	x		Nayak et al., 2007
Hymenaea courbaril L.	tosse	folhas	x		Bezerra et al. 2013
Jatropha gossypiifolia L.	ferimentos	folhas		x	Mariz et al. 2012
Jatropha gossypiifolia L.	Enxaqueca	folhas		x	Apu et al. 2012
Lippia alba (Mill.) N.E.Br. ex Britton & P.Wilson	calmante	folhas	x		Hennebelle et al. 2009
Lippia alba (Mill.) N.E.Br. ex Britton & P.Wilson	dor na coluna	folhas	x		Azis et al.2019
Lippia alba (Mill.) N.E.Br. ex Britton & P.Wilson	calmante	folhas	x		Hatano et al. 2012
Lippia alba (Mill.) N.E.Br. ex Britton & P.Wilson	diarreia	folhas	x		Blanco et al. 2013
Lippia alba (Mill.) N.E.Br. ex Britton & P.Wilson	cólica de criança	folhas	x		Blanco et al. 2013
Lippia alba (Mill.) N.E.Br. ex Britton & P.Wilson	insônia	folhas	x		Toni et al. 2015

Lippia alba (Mill.) N.E.Br. ex Britton & P.Wilson	insônia	folhas	X		Hennebelle et al. 2009
Lippia alba (Mill.) N.E.Br. ex Britton & P.Wilson	insônia	folhas	x		Hatano et al. 2012
Lippia alba (Mill.) N.E.Br. ex Britton & P.Wilson	gases	folhas	x		Blanco et al. 2013
Mesosphaerum pectinatum (L.) Kuntze	inflamação	folhas	x		Santana et al. 2023
Mesosphaerum pectinatum (L.) Kuntze	dor de cabeça	folhas		x	Santana et al. 2024
Momordica charantia L.	verme	fruto	x		Lal et al. 1976
Momordica charantia L.	gastrite	folhas	x		Ferreira Neto 2017
Momordica charantia L.	verme	folhas	x		Cordeiro et al. 2010
Momordica charantia L.	verme	sementes	x		Vedamurthy et al. 2015
Momordica charantia L.	Cancer	Frutos	x		Shobha et al. 2015
Myracrodruon urundeuva Allemão	dor de cabeça	cascas	x		Viana et al. 2003
Myracrodruon urundeuva Allemão	inflamação	folhas	x		Machado et al. 2012
Myracrodruon urundeuva Allemão	inflamação	cascas	x		Viana et al. 2023
Myracrodruon urundeuva Allemão	inflamação	cascas	x		Souza et al. 2007
Myracrodruon urundeuva Allemão	gastrite	cascas	x		Carlini et al. 2010
Myracrodruon urundeuva Allemão	gastrite	cascas	x		Souza et al. 2007
Plectranthus amboinicus (Lour.) Spreng.	dor de ouvido	todas as partes	x		Chiu et al. 2012
Plectranthus amboinicus (Lour.) Spreng.	dor	todas as partes	x		Chiu et al. 2012

Plectranthus amboinicus (Lour.) Spreng.	tosse	folhas	x		Fernández et al. 2009
Plectranthus amboinicus (Lour.) Spreng.	cólicas	folhas	x		Câmara et al. 2003
Plectranthus ornatos Codd.	gastrite	folhas	x		Santos et al. 2014
Psidium guajava L.	diarreia	folhas	x		Lozoya et al. 2002
Psidium guajava L.	diarreia	folhas	x		Lin et al. 2002
Psidium guajava L.	diarreia	folhas	x		Ojewole et al. 2008
Psidium guajava L.	diarreia	folhas	x		Tona et al. 2000
Psidium guajava L.	diarreia	folhas	X		Cáceres et al. 1993
Punica granatum L.	dor de garganta	cascas do fruto	x		Mo et al. 2013
Punica granatum L.	dor de garganta	cascas do fruto	x		Bachoual et al. 2011
Punica granatum L.	dor de garganta	cascas do fruto	x		Assaf et al. 2016
Punica granatum L.	dor de cabeça	folhas	x		Taur et al. 2011
Ricinus communis L.	dor de cabeça	folhas	x		Rajeshkumar et al. 2013
Rosmarinus officinalis L.	úlcera	folhas		x	Tavares 2005
Rosmarinus officinalis L.	asma	folhas	x		Al-Sereiti et al. 1999
Sideroxylon obtusifolium (Roem. & Schult.) T.D.Penn.	ferimentos	folhas	x		Aquino et al.2016
Sideroxylon obtusifolium (Roem. & Schult.) T.D.Penn.	ferimentos	folhas	x		Souza et al. 2020

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6.0. CAPÍTULO 5: CONSIDERAÇÕES FINAIS

6.1 PRINCIPAIS CONCLUSÕES

À luz da Teoria da Evolução Cultural, a realização desta tese trás resultados significativos que ajudam a entender a evolução cultural dos sistemas médicos locais. Por exemplo, os dados obtidos através dos estudos desta tese confirmam as previsões que os sistemas médicos enquanto sistemas sociecológicos, são passíveis a ocorrência de mutações culturais, variações guiadas e traços bioculturais mal adaptados. Aliado á isto, é possível inferir que em sistemas médicos locais, o conhecimento local associado a plantas medicinais é um dos fatores que contribuem para o acúmulo desses processos.

Os nossos dados também sugerem que nos sistemas médicos locais a transmissão cultural por via vertical proporciona menos erros nas informações, sugerindo que adquirir informações com os pais é uma estratégia mais fidedigna para alcançar resultados que visem o tratamento de enfermidades através do uso de plantas medicinais. Também podemos inferir que embora a versatilidade de uso e o compartilhamento de informações sobre plantas medicinais sejam fatores importantes para as pessoas, tais processos podem contribuir para um maior acúmulo de mutações culturais nos sistemas médicos locais. Além disso, por meio dos nossos estudos podemos inferir também que o viés de prestígio é um fator importante no conhecimento local sobre plantas medicinais e que contribui de forma direta para a evolução cultural dos sistemas médicos locais.

Um outro fator importante a ser mencionado é que no cenário que investigamos, embora as pessoas estejam utilizando informações com mutações culturais e que há a presença de alguns traços bioculturais mal adaptados, grande parte das plantas medicinais utilizadas pelas pessoas apresentam atividade

farmacológica comprovada. Dessa forma, mais estudos são necessários para entender as reais implicações que esses processos estão de fato desempenhando para as pessoas nos sistemas médicos locais.

Mediante á isso, esperamos que os resultados desta tese forneçam maiores compreensões sobre o comportamento das culturas humanas nos sistemas médicos locais e que traga maiores compreensões sobre a complexidade dos sistemas socioecológicos. Também esperamos que os nossos dados empíricos contribuam de forma significativa para o entendimento da evolução cultral no cenário de populações humanas e que tragam direcinamentos importantes para estudos etnobotânicos, farmacológicos e bioprospectivos relacionados a plantas medicinais.

Entretanto, salientamos que apesar dos nossos estudos trazerem evidências bastantes significativas, as conclusões dos nossos trabalhos precisam ser relativadas, conforme a existência de algumas limitações (conforme o item 6.3 abaixo).

6.2 CONTRIBUIÇÕES TEÓRICAS E/OU METODOLÓGICAS DA TESE

Os estudos desenvolvidos com esta tese trazem resultados significativos para o campo teórico da Evolução Cultural (EC) (Mesoudi, 2011). Por exemplo, a ocorrência dos fenômenos de mutação cultural, variação guiada e traços mal adaptados vinham sendo discutidos predominantemente apenas por meio de estudos teóricos e matemáticos na evolução cultural. Por sua vez, com a realização desta tese, pudemos testar a validade empírica dos processos microevolutivos da teoria da evolução cultural, conseguindo evidenciar a ocorrência de tais fenômenos no cenário de populações humanas reais, precisamente nos sistemas médicos locais. Dessa forma, os estudos provenientes desta tese tratam-se de um dos primeiros trabalhos que trazem informações empíricas sobre os fatores que contribuem para o acúmulo de mutações culturais, variações guiadas e traços bioculturais mal adaptados em populações humanas.

Além das contribuições para os pressupostos teóricos da teoria da evolução cultural, nossos dados também trazem contribuições importantes para o campo da Etnobiologia Evolutiva (Santoro *et al*., 2018, Albuquerque *et al*., 2020), uma vez que os estudos desta tese evidenciam novas descobertas sobre os aspectos que afetam os conhecimentos e as práticas humanas mediante a inter-relação das pessoas com a natureza. Além disso, os dados desta tese também podem trazer contribuições para outras importantes áreas de conhecimento, tais como; antropologia, ecologia humana, farmácia, psicologia, biotecnologia e entre outras áreas.

6.3 PRINCIPAIS LIMITAÇÕES DO ESTUDO

Ter desenvolvido esta tese durante uma das principais pandemia da humanidade (COVID-19), foi bastante desafiador. Fatores como contaminação pela doença, isolamento social, perda de familiares e amigos próximos foi sem dúvidas muito complicado. Além disso, ter enfrentado um governo que desistimulava a ciência e que desvalorizava totalmente á área ambiental, foi bastante difícil e complicado. Consequentemente, a existência desses fatores desempenharam implicações que de forma direta e indireta afetaram o andamento desta tese.

Adicionalmente, esta tese trata-se de um dos primeiros trabalhos que buscaram avaliar a ocorrência de mutações culturais e de traços bioculturais mal adaptados no cenário de populações humanas, especificamente em sistemas médicos locais. Logo, foi possível constatar a existência de algumas limitações. Por exemplo, para identificar a ocorrência de mutações culturais no conhecimento local, tivemos que realizar entrevistas semiestruturadas com indivíduos transmissores (pessoa que transmitiu a informação) e também com indivíduos aprendizes (pessoa que aprendeu a informação). Porém, em algumas situações conseguimos realizar entrevistas com o indivíduo aprendiz mas não conseguimos realizar entrevistas com o indivíduo transmissor. Isso aconteceu porque alguns indivíduos transmissores não residiam mais na comunidade local, impossibilitando a realização de algumas entrevistas semiestruturadas. Nesse sentido, só foi possível identificar a existência de mutações culturais nos casos que conseguimos realizar as entrevistas semiestruturadas com ambos os indivíduos (transmissores e aprendizes).

Ademais, a realização de entrevistas semiestruturadas foi um dos principais métodos que conseguimos utilizar para investigar a ocorrência de mutações culturais e variações guiadas no conhecimento local. Porém, durante a realização das entrevistas semiestruturadas, ao serem questionados sobre com quem aprenderam as informações sobre plantas medicinais, alguns indivíduos podem não ter se recordado precisamente com quem aprenderam determinadas informações. Além disso, durante a realização das entrevstas semiestruturadas o indivíduo aprendiz pode ter mencionado que utiliza uma determinada planta para curar uma doença diferente da indicada pelo individuo transmissor devido a determinada planta ser versátil. Com isso, devido a limitações relacionadas a memória o mesmo pode não ter se recordado com precisão de todas indicações medicinais associadas a espécie versátil. Diante disso, pensamos que seja importante que próximos estudos sobre mutações culturais e variações guiadas pensem em estratégias ou outros métodos que controlem essas limitações.

Uma outra limitação importante a ser a considerada é que estudos na evolução cultural ainda não evidenciam métodos que possam ser utilizados para diferenciar a ocorrência de mutações culturais da ocorrência de variações guiadas em populações humanas. Para isso, nós utilizamos o uso de entrevistas semiestruturadas, mas assumimos que se faz necessário o desenvolvimento de outros métodos que possam ser utilizados para diferenciar a ocorrência desses processos pelo conhecimento local. Isso ocorrendo, a coleta sobre a ocorrência desses fenômenos será fortalecida e poderá diminuir os riscos de vieses.

Outro fator importante a ser mencionado é que para avaliar a ocorrência de traços bioculturais mal adaptados no sistema médico local, nós dependemos da realização de estudos que tivessem testado a eficiência farmacológica de determinadas plantas medicinais. Por sua vez, não conseguimos encontrar estudos que tivessem testado farmacologicamente todas unidades de informação sobre as plantas medicinais do nosso banco de dados. Consequentemente, isso impossibilitou a classificação de alguns traços bioculturais (se eram de fato mal adaptado ou adaptado). Neste sentido, apesar de ser um pocesso desafiador, acreditamos que seja importante que próximos estudos sobre traços bioculturais mal adaptados considerem essa limitação ou que busque avaliar a atividade farmacológica de determinadas plantas medicinais em labarotório, pois isso pode trazer resultados mais precisos/generalistas e evitar limitações.

6.4 PROPOSTAS DE INVESTIGAÇÕES FUTURAS

Apesar de ser algo bastante desafiador, acreditamos que investigar a ocorrência de mutações culturais e de traços biocultuais mal adaptados é algo extremamente importante para entender a evolução de diferentes culturas humanas e dos sistemas médicos locais. Nesse sentido, incentivamos fortemente a realiação de estudos futuros sobre esses fenômenos e indicamos algumas sugestões que podem ser interessentes de serem investigadas por próximos trabalhos. Por exemplo, atualmente os estudos realizados sobre mutações culturais e traços bioculturais mal adaptados nos sistemas médicos tem considerado como modelo de estudo apenas o conhecimento local sobre plantas medicinais. Dessa forma, próximos estudos sobre mutações culturais e traços bioculturais mal adaptados podem investigar a ocorrência desses fenômenos considerando outros tipos de conhecimento local, como por exemplo, do conhecimento de plantas utilizadas para alimentação humana, conhecimento e uso de animais medicinais, conhecimento de plantas utilizadas para fins madeireiros e etc. Isso pode ser importante para generalizar a ocorrência dos fenômenos de mutações culturais e de traços bioculturais mal adaptados em sistemas

médicos locais. Também incentivamos que outros trabalhos avaliem os pressupostos da evolução cultural no contexto de outras culturas humanas e em outros cenários ambientais, pois isso pode ser importante para entender o comportamento de diferentes culturas humanas dos sistemas médicos locais.

Ademais, descrevemos algumas questões que podem ser importantes de serem refletidas/abordadas em próximos estudos da evolução cultural. Por exemplo: 1) além das entrevistas semiestruturadas, quais outros métodos poderiam ser utilizados para investigar a ocorrência de mutações culturais e variações guiadas nos sistemas médicos locais?; 2) quais outros métodos/alternativas podem ser utilizadas para avaliar a ocorrência de traços bioculturais mal adaptados nos sistemas médicos locais? 3) quais comportamentos/situações podem ser utilizados para exemplificar implicações nêutras das mutações culturais em sistemas médicos locais?; 4) indivíduos de prestígio promovem menos traços bioculturais mal adaptados nos sistemas médicos locais?; 5) sistemas médicos locais que apresentam um maior número de habitantes geram uma maior quantidade de mutações culturais que aqueles com menos habitantes?; 6) como a migração cultural afeta a ocorrência dos fenômenos de mutações culturais e variações guiadas nos sistemas médicos locais?; 7) informações sobre plantas medicinais versáteis proporcionam uma maior quantidade de traços bioculturais mal adaptados?; 8) modos de transmissão cultural mais conservativos promovem uma menor quantidade de traços bioculturais mal adaptados? e 9) pessoas de prestígio aprensetam um conjunto de informações diferenciadas das demais pessoas em sistemas médicos locais?

Mediante os aspectos acima apresentados, esperamos que esta tese sirva como subsídio para gerar novas discussões e que estimule a continuidade de próximos estudos sobre a evolução das culturas humanas e dos sistemas médicos locais.

6.5 ORÇAMENTO (CUSTO DO PROJETO)

Este estudo foi financiado pela Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES), através de bolsa de estudo para o aluno Janilo Italo Melo Dantas. Por sua vez, a execução do projeto exigiu gastos diários com alimentação e transporte para idas aos laboratórios na Universidade. Esses gastos eram diários com média de 30,00. Além disso, pretende-se elaborar a construção de uma cartilha a partir do conhecimento local sobre plantas como forma de divulgação científica e retorno para a comunidade onde o estudo foi realizado. Cada cartilha custará em média 20,00. Dessa forma, esses gastos gerais custaram em média um total de 29.400 R$.

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Anexos- Autorizações Legais

Ministério do Meio Ambiente
CONSELHO DE GESTÃO DO PATRIMÔNIO GENÉTICO

SISTEMA NACIONAL DE GESTÃO DO PATRIMÔNIO GENÉTICO E DO CONHECIMENTO TRADICIONAL ASSOCIADO

Comprovante de Cadastro de

Acesso Cadastro nº A08E877

A atividade de acesso ao Conhecimento Tradicional Associado, nos termos abaixo resumida, foi cadastrada no SisGen, em atendimento ao previsto na Lei nº 13.123/2015 e seus regulamentos.

Número do cadastro:	**A08E877**
Usuário:	**Janilo Italo Melo Dantas**
CPF/CNPJ:	**116.257.314-77**
Objeto do Acesso:	**Conhecimento Tradicional Associado**
Finalidade do Acesso:	**Pesquisa**

Espécie

conhecimento local sobre Plantas medicinais

Fonte do CTA

CTA de origem identificável diretamente com provedor

Provedor

Representante da Comunidade Local

Título da Atividade:	**MUTAÇÕES E TRAÇOS BIOCULTURAIS MAL ADAPTADOS EM SISTEMAS MÉDICOS LOCAIS**

Equipe

Janilo Italo Melo Dantas	**Universidade Federal Rural de Pernambuco**
Ulysses Paulino de Albuquerque	**Universidade Federal de Pernambuco**
Taline Cristina da Silva	**Universidade Estadual de Alagoas**
André Luiz Borba do Nascimento	**Universidade Federal do Maranhão**
Elcida de Lima Araújo	**Universidade Federal e Pernambuco**

Parceiras Nacionais

Data do Cadastro: **03/01/2022 22:06:12**

Situação do Cadastro: **Concluído**

Conselho de Gestão do Patrimônio Genético

Situação cadastral conforme consulta ao SisGen em **22:16** de **0**

SISTEMA NACIONAL DE GESTÃO DO PATRIMÔNIO GENÉTICO E DO CONHECIMENTO TRADICIONAL ASSOCIADO - SISGEN

UNIVERSIDADE DE PERNAMBUCO/ PROPEGE/

PARECER CONSUBSTANCIADO DO CEP

DADOS DO PROJETO DE PESQUISA

Título da Pesquisa: MUTAÇÃO DE INFORMAÇÕES EM SISTEMAS MÉDICOS LOCAIS: AVALIAÇÃO DA PRESENÇA DE TRAÇOS MAL ADAPTADOS EM COMPLEXOS VEGETAIS

Pesquisador: JANILO ITALO MELO DANTAS

Área Temática:

Versão: 2

CAAE: 97380918.9.0000.5207

Instituição Proponente: UNIVERSIDADE FEDERAL RURAL DE PERNAMBUCO

Patrocinador Principal: Financiamento Próprio

DADOS DO PARECER

Número do Parecer: 3.038.231

Apresentação do Projeto:

Trata-se de uma pesquisa a nível de Mestrado do Programa de Pós-graduação em Botânica da Universidade Federal Rural de Pernambuco - UFRPE. Será realizada na comunidade “Lagoa do Junco”, zona urbana do município de Santana do Ipanema - Alagoas. A comunidade foi escolhida para realização do projeto, devido ao fato de possuir um grande histórico de utilização de plantas medicinais, junto ao uso de garrafadas e outras misturas vegetais como parte do seu sistema médico local. Este histórico verificado na comunidade, foi constatado por meio de ações de extensão e pesquisas etnobiológicas que se encontram em andamento, vinculado a Universidade Estadual de Alagoas-UNEAL. Além disso, este histórico também foi informado e reconhecido por meio de agentes comunitários de saúde (ACS) e equipe de enfermagem que fazem parte da secretaria municipal de saúde que atuam na comunidade. Para obtenção dos dados da pesquisa, serão realizados entrevistas semiestruturadas, com todos os adultos maiores de 18 anos da comunidade. Para investigar o conhecimento local sobre plantas medicinais, será utilizada a técnica de Listagem Livre, consistindo em convidar os informantes a listar o nome de todas as plantas conhecidas por eles que possuam alguma finalidade medicinal. Após essa lista se dará sequência entrevistas semiestruturadas, abordando o uso de plantas individuais e em complexos vegetais. Para cada planta citada pelos informantes, serão feitos os seguintes questionamentos: 1) Que doença ou doenças determinada planta é indicada? 2) Quais os sintomas relacionados a esse problema de

saúde? 3) Qual a parte da planta é utilizada no tratamento? 4) Qual o modo de preparo do medicamento? 5) Dessas plantas que foram citadas, tem alguma que é utilizada em consórcio com outras? 6) Se sim, quais outras plantas? 7) Quais problemas de saúde são tratados por essa mistura? 8) com quem obteve este conhecimento? Numa nova etapa, dos complexos vegetais que forem citados, serão abordados para cada participante, dando sequência aos seguintes questionamentos: 1) Se você considera que esta mistura serve para curar determinado problema de saúde, quais das plantas inseridas nesta mistura, apresentam melhor função para isto? 2) Por quê? 3) Têm algumas destas plantas que se forem retiradas, não alteram a função da mistura? 4) Se sim, quais? 5) Por quê? Para a coleta das plantas citadas e indicadas pelos entrevistados, será utilizada a técnica turnê-guiada, na qual, mediante a realização das entrevistas, as pessoas serão convidadas a mostrarem as plantas indicadas da sua residência ou que estejam próximas da mesma.

Objetivo da Pesquisa:

Objetivo Geral: Entender a evolução dos complexos vegetais e o seu papel no acúmulo de informações má adaptadas em sistemas médicos locais.

Objetivos Específicos

1. Identificar as plantas conhecidas como medicinais e quais destas são utilizadas nos complexos vegetais;
2. Verificar a existência de tratamentos ineficientes e eficientes entre as indicações terapêuticas locais;
3. Investigar a existência de mutação de informações no conhecimento local.

Avaliação dos Riscos e Benefícios:

Os pesquisadores informam que os riscos provenientes da pesquisa são que as pessoas podem se sentirem desconfortáveis ao participarem da pesquisa, e se não conhecerem muito pessoalmente sobre o assunto abordado, podem se sentirem desgastadas perante a duração da realização das entrevistas,assustadas perante a visita inicial da comunidade. Para evitar riscos como estes, primeiramente ocorrerá a identificação pessoal da equipe para todas as pessoas da comunidade, cada participante será esclarecido do que se trata a pesquisa, todas as dúvidas serão esclarecidas para todos os participantes, as entrevistas serão realizadas em horário e uma área de suas residências em que se sintam mais confortáveis, as entrevistas serão realizadas de forma bem objetiva para não exceder muito tempo do participante, reduzindo o temponecessário para que não seja desgastante, além disso, será esclarecido o sigilo de todas

as informações pessoais citadas durante as entrevistas.

Como benefícios informam que o desenvolvimento deste projeto, trará contribuições para o avanço de pesquisas que abordem a adesão de variantes culturais em populações humanas, corrobora como um teste e validade empírica de pressupostos teóricos, pois trará colaborações para o entendimento da evolução cultural, e uma melhor compreensão sobre a interferência da cultura no comportamento humano. Além disso, que a compreensão deste projeto poderá trazer subsídio para a elaboração de melhores estratégias a respeito do conhecimento local ligadas as plantas medicinais, e bioprospecção na descoberta de novos fármacos para o tratamento de doenças. E que a partir da realização do projeto, pretende-se elaborar um viés de extensão contribuinte para a comunidade, através da construção de uma cartilha que descreva os diferentes tipos de complexos vegetais, produzidos pelo conhecimento local, descrevendo a produção e a variedade de elementos de cada complexo. A partir da cartilha, as pessoas da comunidade poderão ter uma percepção da grande variedade de informações que está presente culturalmente, e que tornam a ser suscetíveis no conhecimento local. Também, poderá servir como motivação, para que as pessoas da comunidade compreendam a importância e a influência que seus saberes populares vem desempenhando.

Comentários e Considerações sobre a Pesquisa:

A pesquisa foi aprovada após apresentação da carta de anuência do representante legal da comunidade e ajustes de outras pendências descritas no parecer anterior. A pesquisa destina-se apenas a realizar um questionário simples com a população sobre seu conhecimento sobre plantas descritas no projeto.

Considerações sobre os Termos de apresentação obrigatória:

1. TCLE apresentado
2. Currículos lattes dos pesquisadores atualizados
3. Apresenta folha de rosto assinada pela Pró-reitora de pesquisa da UFRPE
4. Apresenta termo de confidencialidade assinado pelos pesquisadores
5. Apresenta carta de anuência do responsável da comunidade local de estudo

Conclusões ou Pendências e Lista de Inadequações:

Projeto aprovado

Considerações Finais a critério do CEP:

O pleno acompanha o parecer do relator.

Este parecer foi elaborado baseado nos documentos abaixo relacionados:

Tipo Documento	Arquivo	Postagem	Autor	Situação
Informações Básicas do Projeto	PB_INFORMAÇÕES_BÁSICAS_DO_PROJETO_1204369.pdf	13/11/2018 20:27:36		Aceito
Outros	ANUENCIACOMUNIDADELOCAL.pdf	13/11/2018 20:12:50	JANILO ITALO MELO DANTAS	Aceito
TCLE / Termos de Assentimento / Justificativa de Ausência	TCLE.docx	13/11/2018 17:40:27	JANILO ITALO MELO DANTAS	Aceito
Projeto Detalhado / Brochura Investigador	PROJETODETALHADO.docx	13/11/2018 17:14:52	JANILO ITALO MELO DANTAS	Aceito
Outros	LATTESANDRE.pdf	28/08/2018 15:11:53	JANILO ITALO MELO DANTAS	Aceito
Outros	LATTESTALINE.pdf	28/08/2018 15:11:26	JANILO ITALO MELO DANTAS	Aceito
Outros	LATTESULYSSES.pdf	28/08/2018 15:11:07	JANILO ITALO MELO DANTAS	Aceito
Outros	LATTESJANILO.pdf	28/08/2018 15:10:25	JANILO ITALO MELO DANTAS	Aceito
Outros	TERMODECOMPROMISSO.pdf	23/08/2018 14:27:36	JANILO ITALO MELO DANTAS	Aceito
Outros	DECLARACAOCOLETADEDADOS.pdf	23/08/2018 14:26:21	JANILO ITALO MELO DANTAS	Aceito
Outros	DECLARACAODERESULTADOS.pdf	23/08/2018 14:25:28	JANILO ITALO MELO DANTAS	Aceito
Outros	TERMODECONFIDENCIALIDADE.pdf	23/08/2018 14:24:55	JANILO ITALO MELO DANTAS	Aceito
Outros	CARTADEANUENCIACOORDENACAO.pdf	23/08/2018 14:16:49	JANILO ITALO MELO DANTAS	Aceito
Folha de Rosto	FOLHADEROSTO.pdf	23/08/2018 14:11:00	JANILO ITALO MELO DANTAS	Aceito

Situação do Parecer:
Aprovado

Necessita Apreciação da CONEP:
Não

RECIFE, 26 de Novembro de 2018

Assinado por:
Jael Maria de Aquino(Coordenador(a)

Endereço: Av. Agamenon Magalhães, s/nº
Bairro: Santo Amaro **CEP:** 50.100-010
UF: PE **Município:** RECIFE
Telefone: (81)3183-3775 **Fax:** (81)3183-3775 **E-mail:** comite.etica@upe.br

Ministério do Meio Ambiente - MMA

Instituto Chico Mendes de Conservação da Biodiversidade - ICMBio

Sistema de Autorização e Informação em Biodiversidade - SISBIO

Comprovante de registro para coleta de material botânico, fúngico e microbiológico

Número: 64841-1	Data da Emissão: 28/08/2018 08:52:20

Dados do titular

Nome: Janilo Italo Melo Dantas CPF: 116.257.314-77

Observações e ressalvas

1	O material biológico coletado deverá ser utilizado para atividades científicas ou didáticas no âmbito do ensino superior.
2	Este documento não abrange a coleta de vegetais hidróbios, tendo em vista que o Decreto-Lei nº 221/1967 e o Art. 36 da Lei nº 9.605/1998 estabelecem a necessidade de obtenção de autorização para coleta de vegetais hidróbios para fins científicos..
3	As atividades de campo exercidas por pessoa natural ou jurídica estrangeira, em todo o território nacional, que impliquem o deslocamento de recursos humanos e materiais, tendo por objeto coletar dados, materiais, espécimes biológicos e minerais, peças integrantes da cultura nativa e cultura popular, presente e passada, obtidos por meio de recursos e técnicas que sedestinem ao estudo, à difusão ou à pesquisa, estão sujeitas a autorização do Ministério de Ciência e Tecnologia.
4	Esse documento não eximirá o pesquisador da necessidade de obter outras anuências, como: I) da comunidade indígena envolvida, ouvido o órgão indigenista oficial, quando as atividades de pesquisa forem executadas em terra indígena; II) do Conselho de Defesa Nacional, quando as atividades de pesquisa forem executadas em área indispensável à segurançanacional; III) da autoridade marítima, quando as atividades de pesquisa forem executadas em águas jurisdicionais brasileiras; IV) do Departamento Nacional da Produção Mineral, quandoa pesquisa visar a exploração de depósitos fossilíferos ou a extração de espécimes fósseis; V) do órgão gestor da unidade de conservação estadual, distrital ou municipal, dentre outra
5	Este documento não é válido para: a) coleta ou transporte de espécies que constem nas listas oficiais de espécies ameaçadas de extinção; b) recebimento ou envio de material biológico ao exterior; e c) realização de pesquisa em unidade de conservação federal ou em caverna.
6	Este documento não dispensa o cumprimento da legislação que dispõe sobre acesso a componente do patrimônio genético existente no território nacional, na plataforma continental ena zona econômica exclusiva, ou ao conhecimento tradicional associado ao patrimônio genético, para fins de pesquisa científica, bioprospecção e desenvolvimento tecnológico. Veja maiores informações em www.mma.gov.br/cgen.

Táxons autorizados

#	Nível taxonômico	Táxon(s)
1	Reino	Plantae

Este documento foi expedido com base na Instrução Normativa nº 03/2014. Através do código de autenticação abaixo, qualquer cidadão poderá verificar a autenticidade ou regularidade deste documento, por meio da página do Sisbio/ICMBio na Internet (www.icmbio.gov.br/sisbio).

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Comprovante de registro para coleta de material botânico, fúngico e microbiológico

Número: 64841-1	Data da Emissão: 28/08/2018 08:52:20

Dados do titular

Nome: Janilo Italo Melo Dantas CPF: 116.257.314-77

Registro de coleta imprevista de material biológico

De acordo com a Instrução Normativa nº03/2014, a coleta imprevista de material biológico ou de substrato não contempladona autorização ou na licença permanente deverá ser anotada na mesma, em campo específico, por ocasião da coleta,devendo esta coleta imprevista ser comunicada por meio do relatório de atividades. O transporte do material biológico ou dosubstrato deverá ser acompanhado da autorização ou da licença permanente com a devida anotação. O material biológico coletado de forma imprevista, deverá ser destinado à instituição científica e, depositado, preferencialmente, em coleção biológica científica registrada no Cadastro Nacional de Coleções Biológicas (CCBIO).

Táxon*	Qtde.	Tipo de Amostra	Qtde.	Data

* Identificar o espécime do nível taxonômico possível.

Este documento foi expedido com base na Instrução Normativa nº 03/2014. Através do código de autenticação abaixo, qualquer cidadão poderá verificar a autenticidade ou regularidade deste documento, por meio da página do Sisbio/ICMBio na Internet (www.icmbio.gov.br/sisbio).

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