ISSN: 2175-8018

IJIE Iberoamerican Journal of Industrial Engineering

POTENTIAL REVALORIZATION MEANS FOR THE ACAI PULP PRODUCTION WASTE AS GUIDELINES FOR THE STRUCTURE OF REVERSE CHANNELS: A LITERATURE REVIEW

Vitor Martins [1]
Leonardo Bastos [2]
Denilson Nunes [3]
André Melo [4]
Kamila Ribeiro [5]
Thaymara Barbosa [6]
Davi Ferraz [7]

ABSTRACT: This paper aimed to identify the potential means of revaluation of the acai pulp production waste (APPW) already published, to be used as guidelines for structuring reverse channels (RC), since the lack of alternatives regarding the reuse of these waste may result in inadequate disposal. For this research, 52 published papers from 2010 to September 2021 were analyzed, considering 2010 as the year that National Solid Waste Policy (NSWP) was established. With the identification of possible APPW revalorization alternatives, it was possible to prove different destination options for this waste as well as to guide RC structuring possibilities, which benefits different productive sectors, such as energy, water treatment, medicine, food, technology, crafts, composites and substrate. Finally, it was also observed that in 97% of the identified studies there were Brazilian researchers involved and the most researched alternatives so far are substrate, composites and energy.

KEYWORDS: Waste Revalorization. Reverse Channels. Acai. Acai Pulp Production Waste.

[1] **Universidade do Estado do Pará (UEPA) - vitor.martins@uepa.br**
[2] **Pontifícia Universidade Católica do Rio de Janeiro (PUC-Rio) - lslbastos@gmail.com**
[3] **Universidade do Estado do Pará (UEPA) - denilson.lucena@gmail.com**
[4] **Universidade do Estado do Pará (UEPA) - acsmelo@uepa.br**
[5] **Universidade do Estado do Pará (UEPA) - kamila.ribeiro0317@gmail.com**
[6] **Universidade do Estado do Pará (UEPA) - barbosathaymara@gmail.com**
[7] **Universidade do Estado do Pará (UEPA) - davipaivaferraz@gmail.com**

1 INTRODUCTION

With the increase in population, technological advances, consumption and disposability, the has been a higher quantity of waste generation in Brazil, reaching 76,756,215 tons only in 2019 (ABELPRE, 2020), consequently, the concern of parts of society with the adequate destination of this waste. It is noticed several economic activities generate considerable amounts of solid waste, which, independently of the volume, if poorly managed to its destination, cause changes in the environment and require appropriate Reverse Channels (RC) (MACEDO *et al*., 2006).

According to Pinsky, Dias and Krugliankas (2013, p. 465), "the increasing importance of sustainability in recent years has led some companies to consider, as an integral part of business strategy, the inclusion of business goals compatible with sustainable development". However, many challenges need to be overcome in the political, social, economic and technical fields to address the problems of generation, collection, transportation and waste treatment (LIAMSANGUAN and GHEEWALA, 2008).

Solid Waste (SW) constitute (BRAZIL, 2016):

> Any material, substance, object or disposed good as a result from human activities in society, to which final destination is made, it is proposed to proceed or it is obliged to proceed, in solid or semi-solid states, as well as gases confined in containers and liquids whose peculiarities make infeasible its disposal in the public sewage system or in water bodies, or require infeasible technically or economically solutions in the face of the best available technology.

If poorly managed, such waste may be subject to be treated as scraps, being transported directly to final disposal points, environmentally adequate or not, without any possibility of revalorization, which contributes to the quick capacity exhaustion on these points and losses of opportunity for economic and social benefits from a more appropriate management.

Hence, the adequate management of SW has contributed to natural resources preservation, either through prevention or through recycling and revalorization, which allows the achievement of environmental objectives. In this sense, the revalorization of SW has become a prominent issue (SANTOS *et al*., 2016). Ochôa and Lhamby (2016, p. 920) describe Reverse Logistics (RL) as capable of performing waste revalorization, reducing their quantity and increasing the competitiveness of companies.

According to Leite (2003), Reverse Channels (RC) are steps, ways or means by which process waste should be driven, in order to return to productive or business cycles (same, similar or different), increasing their survival from reuse or revalorization (recycling, composting, etc.), or from their environmentally appropriate final disposal. A possible structure of RC with processes and flows can be observed in Figure 1, in which one can verify that since its generation, when going through the RC processes, the SW go through successive stages of value aggregation until its adequate revalorization option, from which only scraps originated from these processes are routed to environmentally adequate final disposal sites.

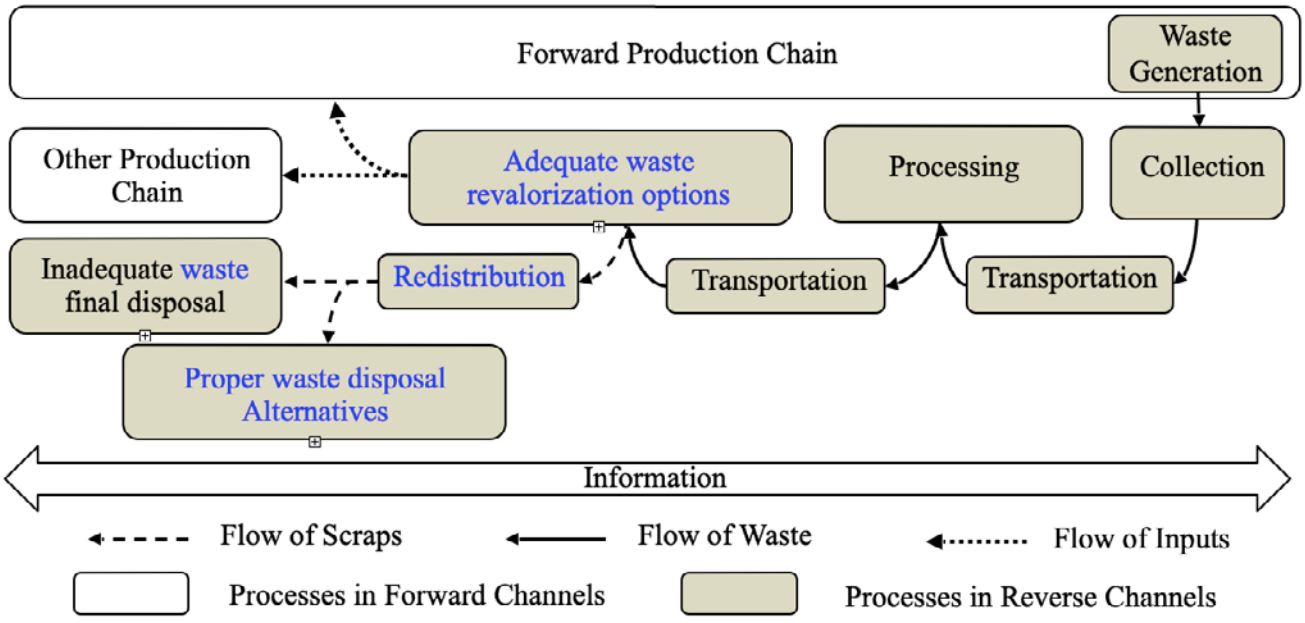

Figure 1: Possible general structure of reverse channels

Acai is an important economic source in the North region of Brazil. According to SEDAP (2020), the State of Pará is the largest producer of pulp, corresponding to 94.41% of all production in the country. Among the cities in this state with the highest production of açaí pulp, in 2014, the most prominent were Castanhal-PA, in the Metropolitan Region of Belém (RMB), with 24,258,839 kg, and Belém-PA, the state capital, with 5,773,123 kg. In 2014, the amount of pulp exported was 5,462,534 kg, and its national commercialization is directed to the states of São Paulo, Rio de Janeiro and Minas Gerais, major domestic customers, and to other countries such as the United States and Japan, which are the major importers (VEDOVETO, 2008; TAVARES; HOMMA, 2015). The great issue in this context is that, to produce this amount of pulp, adopting the proportion proposed by Sagri (2010), of 15% of pulp to 85% of waste, only in 2014 these cities generated more than 170,000 tons of waste, an average of 460 tons/day.

The waste generated in the acai pulp process is composed of stones and thicker layers of the acai pulp that were retained in the sieve process (COSTA, 2014). The fibers are present in the mesocarp coating and in the pulp of the fruit, being a byproduct of the pulp process. Although they correspond to lignocellulosic materials, these SW are often disposed illegally in the environment, becoming pollutant when disposed at the margins of water springs, being responsible for the reduction in dissolved oxygen rates in water and eutrophication (LIMA JUNIOR, 2007). According to Teixeira et al. (2006, p.21), the acai stone is a rich source of carbon, with a content above 48%, a feature that makes this residue widely used as an input in composting or in the production of organic fertilizer.

In this context, the adequate waste revalorization of agricultural by-products, such as the acai pulp production waste (APPW), becomes imperative, considering that, over the years, the generation of this waste has become a socio-environmental problem. Moreover, as the adequate waste revalorization is able to provide new profitable products, such as acai stone, which can be used as biomass (CARNEIRO *et al.*, 2013), with the appropriate RC structuring, it will be possible to create or to identify potential opportunities for sustainable gains, from the capture of SW from the environment and pollution reduction (environmental benefits), generation of new jobs (social benefits) and, consequently, income generation (economic benefits) for society.

In this way, this research identified the alternative means of waste revalorization, already proposed in the Literature for the sustainable destination, recommended by the National Solid Waste Policy (NSWP), specifically of APPW, with the perspective to identify potential guidelines for the structure of RCs towards the environmentally adequate final destination and risk reduction of final disposal of these SW.

2 RESEARCH METHOD

According to Sampaio and Mancini (2006), the systematic review, as well as other review methods, consists of the research that uses as data the literature regarding a given topic. To its development, techniques are applied with the purpose of collecting and obtaining in sources of the literature information that contributed to the identification of different means of APPW revalorization, published from 2010 to September 2021.

The initial procedure for the research development was to define the research topic and afterwards the literature review was performed, considering as selection criteria, the evaluation and extraction of information in papers published since 2010, the year in which the NSWP was approved. The assessment of information from the obtained articles was executed by a thorough reading of their content. Thus, it was identified the current APPW revalorization means already published in the literature. Consequently, it was performed a synthesis of the collected information as well as its presentation and discussion, considering the association of the revalorization means and potential RC structures capable of supporting them. The research steps were developed in a logical sequence detailed as follows:

a) Definition of Research Guidelines

Following the objective of this study, to characterize the context of the current research developed in the literature on the revalorization of APPW, as an assistance to guide the structuring of potential RCs, in this initial stage, the keywords were defined in Portuguese (“Revalorization of Waste”, “Acai”, “Acai Waste”, “Reverse Channels”) and English (“Waste Revalorization or Appreciation”, “Acai Waste”, “Reverse Channels)”, as well as the research questions (RQ) that guided the review. In Table 1, these RQ are presented and associated with their research objectives.

Table 1 - Research questions and objectives

Research Questions	Research Objectives
What and how many studies were published with topics related to APPW revalorization between 2010 and September 2021?	Perform the qualitative and quantitative literature research related to the current papers on the APPW revalorization
What are the revalorization considered in literature?	What are the revalorization considered in literature?

Fonte: Enermac (2019)

b) Literature research

The literature research was performed with the use of keywords defined in the previous step, considering the search, in renowned databases (See Table 2), for publications related to the topic. For this purposed, the period of 2010- September 2021 was established as a criterion for the survey, due to 2010 being the year in which the NSWP was approved in Brazil. Finally, during this step, the keywords were also combined with words associated to common revalorization alternatives for agrosilipastoral waste. In Table 2 one can observe the review protocol which leads this research.

c) Analysis of identified papers and information extraction

The papers were analyzed by means of a complete reading of their contents in order to ensure that the questions initially proposed were answered with consistency and that they comply with the studied topic.

Table 2 - Literature Review Protocol

<table>
<tr><td colspan="4">Research Question: “What are the current revalorization alternatives for the acai pulp production waste present in literature published between 2010 and 2016 that can be used to structure specific reverse channels?”</td></tr>
<tr><th>Keywords</th><th>Period</th><th>Inclusion Criteria</th><th>Databases</th></tr>
<tr><td rowspan="2">Waste revalorization</td><td rowspan="7">2012 - 2021</td><td>Papers published in journals and conferences (national and international)</td><td>Web of Science</td></tr>
<tr><td rowspan="3">Reverse Channels</td><td rowspan="2">Papers relating the research Keywords to the waste destination alternatives (energy, substrate, composites, technology, water, food, medicine, etc.), in title, abstract or keywords.</td><td>Google Scholar</td></tr>
<tr><td rowspan="2">SCOPUS</td></tr>
<tr><td rowspan="2">Acai</td><td>Papers in English or Portuguese</td><td>CAPES Journals</td></tr>
<tr><td>Exclusion Criteria</td><td>PROQUEST</td></tr>
<tr><td rowspan="2">Acai Waste</td><td>Papers in other languages</td><td>Scielo</td></tr>
<tr><td>Duplicated papers</td><td>Blackwell Synergy</td></tr>
</table>

d) Information synthesis and presentation of obtained results

After extracting the required information (answers), these were synthesized and organized to facilitate the presentation of the answers, i.e., it was verified the alternatives currently proposed in the selected papers for the APPW destination/revalorization and the origins of these surveys. For each criteria of analysis (guiding question), it was also identified the most frequent alternatives. These results were presented in graphs and tables, according to the information characteristics considered in this research.

3 CLASSIFICATION AND RESULTS DISCUSSION

This section presents the results from the analysis of papers identified as researches on the APPW revalorization alternatives published between 2010 and September 2021.

As of 2011, it was possible to observe that, since past decade, there has been greater concern with the development of studies that propose new alternatives for the APPW revalorization and, among the possible reasons for this trend, there are probably the impacts of NSWP approval (Legal Factors) since 2010, or the problems that the inadequate waste disposal has caused to society (Environmental Factors), especially in regions near to pulp production sites (waste generation) or in the current waste disposal sites.

With literature research, 90 publications were identified, corresponding to national (36) and international papers (journals and conferences) (54). Among those papers, there are publications aimed at a wide variety of APPW revalorization alternatives. As shown in Table 3, the revalorization options Substrate, Energy Generation and Composite led the number of publications using APPW as input. Although in minor rate, recovery options as using for water treatment, technology, medicine, handcrafting and food were also identified in literature.

However, it is verified the need for more research directed to these areas since, besides they already contribute with APPW consumption and in many cases with the reduce in consumption of natural resources (environmental value), they are important sources of benefits for society (infrastructure, health, art, etc.). From the results presented in Table 3, it is clear the predominance of research in Brazil, which is presented in 97% of the identified papers. It was observed that the most representative Brazilian states in researches related were Pará and Amazonas. In addition, in recent years there has been a lot of research partnerships between Brazilian universities, as well as international ones.

Table 3 - Classification of selected studies on the APPW revalorization

Keywords	Author (Year) – [States]	Country
Energy Generation	Luczynski *et al*. (2011); Carneiro *et al.* (2013); Itai *et al*. (2014); Kühl *et al.* (2014); Souza *et al.* (2015); Muniz & Rocha (2013); Fragoso *et al*. (2014); Gonçalves *et al.* (2015) – [Pará]; Virmond *et al.* (2012); Barbosa Neto *et al.* (2014); Rambo, Schmidt & Ferreira (2015); Sganzerla *et al*. (2021); Ferreira et al.(2021) - [São Paulo]; Santos & Júnior (2016); Araujo *et al.* (2021) – [Amazonas]; Teixeira *et al*. (2013) – [Rio de Janeiro]; Nagata *et al.* (2020) - [Minas Gerais]; Bufalino *et al*. (2018) - [Minas Gerais e Amapá]; Costa *et al*. (2020) - [Minas Gerais e Pará]; Alves *et al*. (2021) - [Santa Catarina; Paraná; Paraíba]	BR
	Reis *et al*. (2019) - [Budapest]	HN
Water Treatment	Pereira *et al*. (2014) – [Pará]; Gonçalves Jr. *et al.* (2016) – [Paraná]; Queiroz *et al*. (2020) – [Pará and Amazonas]; Pessôa et al. (2019) - [Pernambuco; Paraíba]; Gonçalves *et al.* (2019) - [Pernambuco; Paraná];	BR
	Maciel-Silva, FW; Mussatto, SI and Forster - Carneiro, T. (2019) – [Pará; Kongens, Lyngby]	BR/DK
	Gonçalves *et al*. (2021) – [Paraná; Macul]	BR/CH

Keywords	Author (Year) – [States]	Country
Substrate	Maranho & Paiva (2011); Maranhob & Paiva (2012); Maranhoa & Paiva (2012); Maranho, Paiva, Paula (2013); Paula, Paiva e Maranho (2013); Leão, Paiva & Lima (2012); Leão *et al*. (2012); Maranho & Paiva (2011) – [Acre]; Soares *et al*. (2014) – [Paraná; Acre]; Erlacher *et al*. (2016); Erlachera *et al*. (2014); Erlacher *et al*. (2013); Erlacherb *et al*. (2014) – [Espírito Santo]; Fonseca, Barroncas & Teixeira (2014); Weckner *et al*. (2016); Rodrigues et al. (2016); Santos and Cavallazzi (2017); Sales-Campos *et al*. (2021) – [Amazonas]; Souza *et al*. (2019) – [Pará e Amazonas]; Souza *et al*. (2019) - [Pará; Amazonas]; Garcia, Oliveira, Silva (2012) – [Amapá]; Pires *et al*. (2012) – [Pará]	BR
	Albuquereu *et al*. (2021) – [Santiago of Compostela; Pará]	SP/BR
	Valencia & Jardim (2014) – [Caquetá]	CO
Composite	Castro, Dias, Faria (2010) - [São Paulo; Pará]; Valença *et al*. (2011) – [Amazonas]; Costa *et al*. (2014); Mares et al. (2021); Guedes *et al*. (2021) – [Pará]; Goes, Moreno & Tavares (2014); Wataya *et al*. (2015) - [São Paulo]; Martins *et al*. (2021); Monteiro *et al*. (2021); Marvila *et al*. (2020) – [Rio de Janeiro]; Sato *et al*. (2019) - [Pará, Amazonas and Piauí]; Oliveira *et a*l. (2019); Braga *et al*. (2021) - [Pará, Amapá, Minas Gerais e São Paulo]; Dias *et al*. (2019) -[Pará, Minas Gerais e Amazonas]; Romani *et al*. (2021) – [Rio de Janeiro; Rio Grande do Sul]; Ballboni *et al*. (2019) – [São Paulo; Pará];	BR
	Mesquita *et al*. (2018) – [Amazonas, Motería, São Paulo; Pará]	BR/CO
	Rocha *et al*. (2021) – [Rio de Janeiro; Minas gerais; Firenze]	BR /IT
	Azevedo *et al*.(2021) – [Rio de Janeiro; Gaza]	BR/PL
	Nascimento *et al*. (2020) – [Pernambuco; Porto; Paraíba]	BR/PT
	Sato *et al*. (2020) – [Pará, Piaui; Paraná; Nottingham]	BR/UK
	Souza *et al*. (2020) – [Pará; Amazonas; Ohio]	BR/USA
Tech.	Bastos, Melo & Soeiro (2012) – [Santa Catarina; Pará] Alecrim *et al*. (2015) – [Amazonas]; Bentes *et al*. (2021) - [Amazonas; Pernambuco]; Zavarize (2021) – [Maranhão]	BR
	Souza *et al*. (2020) – [São Paulo; Amazonas; Ohio]	BR/USA
Med.	Barros *et al*. (2015) - [Minas Gerais]	PT/SP/BR
	Nascimento *et al*. (2016) – [Pará]; Gonçalves, Santos & Srebernich (2011); Melo *et al*. (2016) - [São Paulo]; Martins *et al*. (2020) – [Rio de Janeiro; Santa Catarina]	BR
Handc.	Oliveira et al. (2014); Brandão *et al*. (2015); Neu *et al*. (2016); Gonçalves *et al*. (2012) – [Pará]; Silva, Munhoz & Araujo (2014) – [Amazonas]	

Keywords	Author (Year) – [States]	Country
Food	Gomes *et al*. (2012); Lima *et al.* (2015) – [Pará]; Zavarize *et al.* (2021); Zavarize and Oliveira (2021) – [Maranhão]	BR
	Buratto; Cocero and Martín (2021) – [Valladolid]	SP
Legend: BR – Brazil; SP-Spain; IT - Italy; USA – United Estates; UK - United Kingdom; PT – Portugal; PL – Palestine; CL – Colombia; CH – Chile; DN – Denmark; HN - Hungary		

In Figure 2 the distribution of the articles identified among the APPW revalorization options. Hence, 21 (23%) papers proposed Substrate as reuse alternative of APPW; 21 (23%) proposed Energy Generation, and 21 (23%) proposed some Composite acai-waste-based. Thus, it is possible that APPW research have been oriented to the reuse as an alternative input in the industry, according to the papers from 2010 to September 2021. There are evidences in literature that the interest in different ways of revalorization APPW is growing, though for alternatives such as water treatment, technology, medicine, handcrafting and food, such growth is still tiny (see Figure 3).

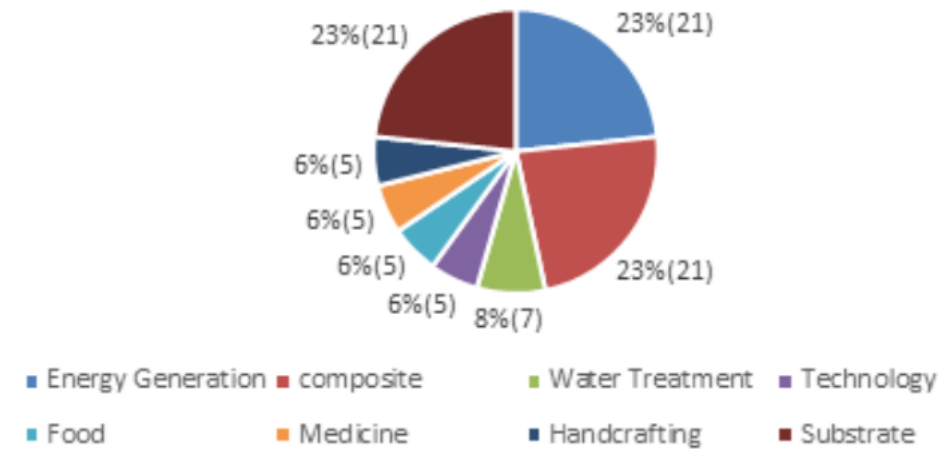

Figure 2: Distribution of selected papers per APPW revalorization alternatives.

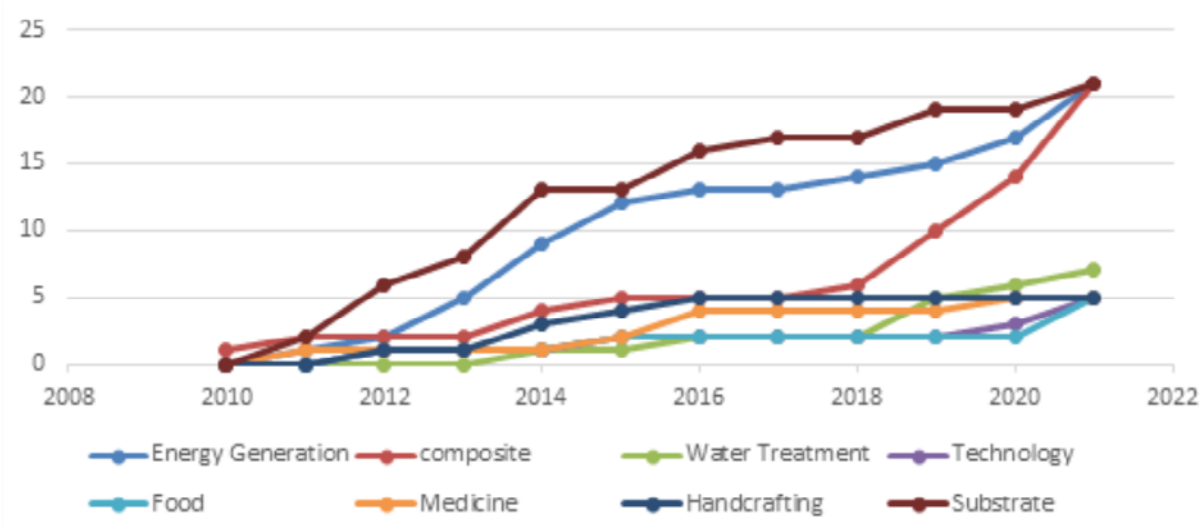

Figure 3: APPW revalorization alternatives papers accumulated per year.

Although it was considered only papers from the defined period, it was possible to characterize the current context of the research on the APPW revalorization, regarding potential destination alternatives. Hence, from the identified revalorization options in the literature it was possible propose a more specific RC structure for each APPW destination alternative, according to Figure 4.

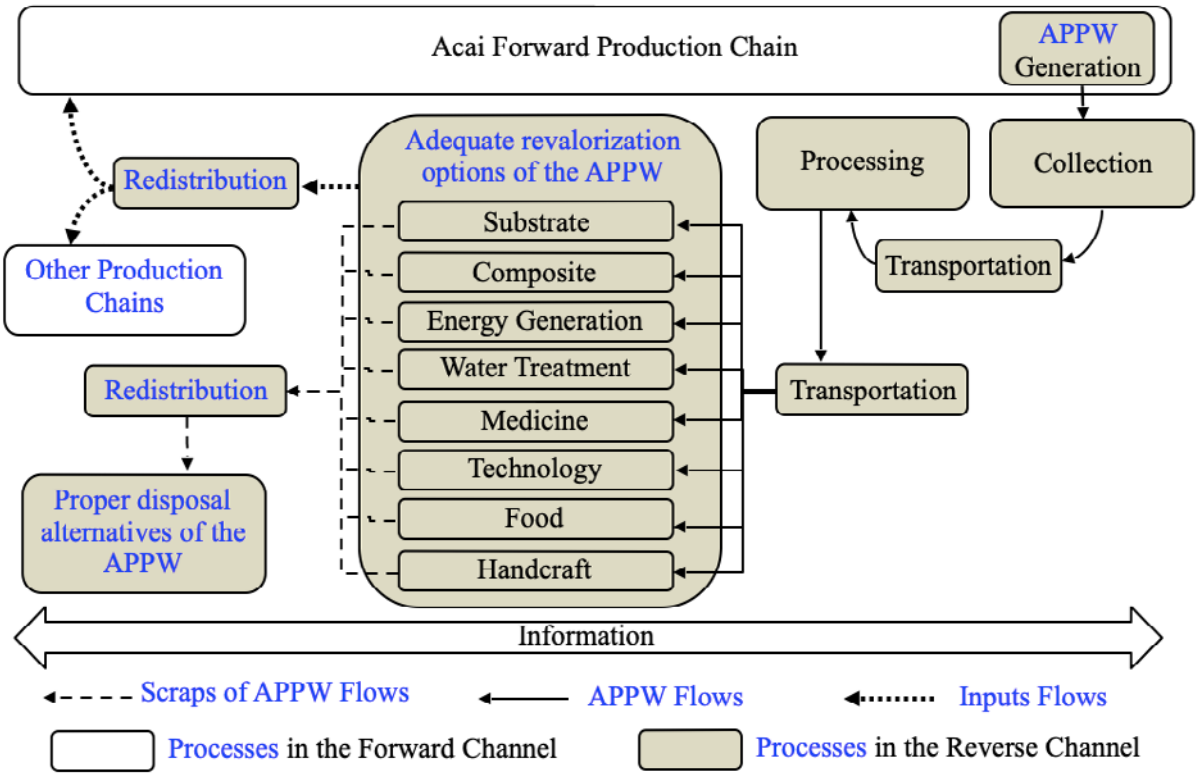

Figure 4: Reverse Channels for the APPW revalorization.

Thus, knowing all the activities that are part of each APPW revalorization process can help to identify common and specific steps, resources and agents, i.e., important details that can make a difference in decision-making to plan and structure more feasible related RC, including reverse logistics processes.

4 CONCLUSION

Considering the current context of acai pulp production and consumption growth at world levels, and that the waste generation from this process (stone, fibers and microfibers) has been reaching proportionally high quantities annually, by means of literature review, this study identified the potential alternatives, among those already formalized in literature towards the APPW revalorization, providing potential guidelines for the structure of specific RCs aimed at the environmentally adequate destination of these wastes, thus reaching their objectives satisfactorily.

Regarding the alternative APPW revalorization means proposed in the literature, even though only papers published between 2010 and September 2021 were selected, 90 articles were identified and organized in the following groups of revalorization alternatives: Food (5 or 6%), Handcraft (5 or 6%), Composites (21 or 23%), Energy generation (21 or 23%),

Medicine (5 or 6%), Substrate (21 or 23%), Technology (5 or 6%), and Water Treatment (7 or 8%), which represents a great variety of researches related to this topic, which drives a similar possibility of RC structures towards the reuse of APPW. Furthermore, it was verified the dominance of Brazil (97%), as country, and of Pará and Amazonas, as Brazilian states, on the research related to the topic.

In order to identify, explore and disseminate studies on the APPW revalorization means, this study generated results capable of encourage discussions and assist new researches referring to the structuring of specific RCs for APPW, from the identification of the current forms of APPW revalorization proposed in literature (current and potential), considering its feasibility from economic, technological, logistic, environmental, social, legal, etc. factors (1) and the NSWP influence (legal component), for the development of studies towards the proposal of new alternatives for environmentally adequate final destination (2) as well as for the definition of more viable APPW RCs, considering local or regional specificities and the current revalorization means already proposed in the literature, jointly identified in this research (3).

POSSÍVEIS MEIOS DE REVALORIZAÇÃO PARA OS RESÍDUOS DA PRODUÇÃO DE CELAS DE AÇAÍ COMO DIRETRIZES PARA A ESTRUTURA DE CANAIS REVERSOS: UMA REVISÃO DA LITERATURA

RESUMO: Este trabalho teve como objetivo identificar os potenciais meios de reavaliação dos resíduos da produção de polpa de açaí (RPPA) já publicados, a serem utilizados como diretrizes para estruturação de canais reversos (CR), uma vez que a falta de alternativas quanto ao reaproveitamento desses resíduos pode resultar em inadequação disposição. Para esta pesquisa, foram analisados 52 artigos publicados de 2010 a setembro de 2021, considerando 2010 como o ano de implantação da Política Nacional de Resíduos Sólidos (PNRS). Com a identificação de possíveis alternativas de revalorização de RPPA, foi possível comprovar diferentes opções de destinação para esses resíduos, bem como orientar possibilidades de estruturação da RC, que beneficia diferentes setores produtivos, como energia, tratamento de água, medicamentos, alimentos, tecnologia, artesanato, etc. compósitos e substrato. Por fim, também foi observado que em 97% dos estudos identificados havia pesquisadores brasileiros envolvidos e as alternativas mais pesquisadas até o momento são substrato, compósitos e energia.

PALAVRAS-CHAVE: Revalorização de Resíduos. Canais reversos. Açaí. Resíduos da produção de celulose de açaí.

Originais recebidos em: 20/10/2021
Aceito para publicação em: 13/12/2021

REFERENCES

ABELPRE. Associação Brasileira de Empresas de Limpeza Pública e Resíduos Especiais. **Panorama dos Resíduos Sólidos no Brasil – 2020**. 2020. http://www.abrelpe.org.br/ . (Accessed March 22, 2021).

ALECRIM, M. M.; PALHETA, R. A.; TEIXEIRA, M. F. S.; OLIVEIRA, I. M. D. A. Milk-clotting enzymes produced by Aspergillus flavo furcatis strains on Amazonic fruit waste. **International Journal of Food Science & Technology**, v. 50, n. 1, p. 151 - 157, 2015. DOI: 10.1111/ijfs.12677.

ALVES, J.L.F., DA SILVA, J.C.G., DI DOMENICO, M., GALDINO, W.V.D.A., ANDERSEN, S.L.F., ALVES, R.F., DE SENA, R.F. Exploring Açaí Seed (Euterpe oleracea) **Pyrolysis Using Multi-component Kinetics and ThermodynamicsAssessment Towards Its Bioenergy Potential. Bioenergy Research**. V 14 (1), pp. 209-225, 2021. DOI:10.1007/s12155-020-10175-y.

ARAUJO, R.O., SANTOS, V.O., RIBEIRO, F.C.P., CHAAR, J.D.S., PEREIRA, A.M., FALCÃO, N.P.S., DE SOUZA, L.K.C. Magnetic acid catalyst produced from acai seeds and red mud for biofuel production. **Energy Conversion and Management**. V 228, 2021. DOI: 10.1016/j.enconman.2020.113636.

AZEVEDO, A.R.G., MARVILA, M.T., TAYEH, B.A., CECCHIN, D., PEREIRA, A.C., MONTEIRO, S.N. Technological performance of açaí natural fibre reinforced cement-based mortars. **Journal of Building Engineering**. V33, 2021. DOI: 10.1016/j.jobe.2020.101675.

BALBONI, B.M., DE SOUSA, J.T.R., FERREIRA, M.A., RODRIGUES, R.A., MACEDO, A.B. Residue of açaí berry (Euterpe oleracea) management as a source of lignocellulosic material. **European Journal of Wood and Wood Products**. V 77 (4), pp. 509-516, 2019. DOI:10.1007/s00107-019-01417-8.

BARBOSA NETO, A. M.; LIMA, J. O.; MARQUES, L. G.; PRADO, M. M. Secagem infravermelho de caroços de açaí para a obtenção de biomassa, p. 5451 - 5458 . In: **Anais do XX Congresso BReiro de Engenharia Química - COBEQ 2014** [Blucher Chemical Engineering Proceedings, v.1, n.2]. São Paulo: Blucher, 2014. DOI: 10.5151/chemeng-cobeq2014-0554-24974-159341

BARROS, L.; CALHELHA, R. C.; QUEIROZ, M. J. R., SANTOS-BUELGA, C.; SANTOS, E. A.; REGIS, W. C.; FERREIRA, I. C. The powerful in vitro bioactivity of Euterpe oleracea Mart. seeds and related phenolic compounds. **Industrial Crops and Products**, v. 76, p. 318 - 322, 2015.

BASTOS, L. P.; MELO, G. S. V.; SOEIRO, N. S. **Panels manufactured from vegetable fibers**: An alternative approach for controlling noises in indoor environments. Advances in Acoustics and Vibration, v. 2012, 2012.

BRAGA, D.G. , DE ABREU, J.L.L., DA SILVA, M.G., DE SOUZA, T.M., DIAS, M.C., TONOLI, G.H.D., DE OLIVEIRA NETO, C.F.,CLARO, P.I.C., GOMES, L.G., BUFALINO, L. **Cellulose nanostructured films from pretreated açai mesocarp fibers**: Physical, barrier, and tensile performance. Cerne. V 27 (1), 2021. DOI: 10.1590/01047760202127012783.

BRANDÃO, R. F. B.; BARROS, A. L.; LAMEIRA, C. C.; PALHETA, F. C.; GALVÃO, J. R. **O Açaí no Estado do Pará e seu Potencial para o Desenvolvimento Sustentável da Região**. In: Congresso Técnico Científico da Engenharia e da Agronomia - CONTECC, 2015.

BRASIL. Ministério da Saúde. Secretaria de Ciência, Tecnologia e Insumos Estratégicos. Departamento de Ciência e Tecnologia. **Diretrizes metodológicas**: elaboração de revisão sistemática e metanálise de ensaios clínicos randomizados. Brasília: Editora do Ministério da Saúde, 2012. 92 p.: il. – (Série A: Normas e Manuais Técnicos).

BRASIL. **Política Nacional de Resíduos Sólidos**. Lei nº 12.305, de 2 de agosto de 2010. 3ª Edição (reimpressão), Diário Oficial da [União]. Brasília, DF, 2016.

BUFALINO, L; GUIMARAES, AA; SILVA, BMDE; DE SOUZA, RLF; DE MELO, ICNA ; DE OLIVEIRA, DNPS; TRUGILHO, PF. Local variability of yield and physical properties of acai waste and improvement of its energetic attributes by separation of lignocellulosic fibers and seeds. **Journal of Renewable and Sustainable Energy**. V10 (5), 2018. DOI: 10.1063/1.5027232.

BURATTO, R.T., COCERO, M.J., MARTÍN, Á. Characterization of industrial açaí pulp residues and valorization by microwave-assisted extraction. **Chemical Engineering and Processing** - Process Intensification V 160, 2021. DOI:10.1016/j.cep.2020.108269.

CARNEIRO, J. S.; CAVALCANTE, B. S.; SILVA, M. D. B.; SILVA, R. S. Estudo da viabilidade do aproveitamento energético da queima de caroços de açaí produzidos no Município de Castanhal - PA. **Amazônia em Foco**: Ciência e Tecnologia, v. 2, n. 2, p. 47 - 63, 2013.

CASTRO, C. D. P. C.; DIAS, C. G. B. T.; FARIA, J. A. F. **Production and evaluation of recycled polymers from acai fibers**. Materials Research, v. 13, n. 2, p. 159 - 163, 2010.

CAVALCANTI, M. A.; VIDAL, T. C. S. **Estudo do Potencial do Resíduo do Açaí para Celulose e Papel**. 2011.

COSTA, A. S. G.; ROCHA, K. B.; BRITO, S. C. S., ANDRADE, S. M. C. **Ensaios de Tração e Absorção de Água em Compósitos de Resina Poliéster e Fibra de Açaí**. In: Anais do 21º CBECIMAT - Congresso Brasileiro de Engenharia e Ciência dos Materiais. 09 a 13 de Novembro, Cuiabá, MT, Brasil, 2014.

COSTA, J.S., DA SILVA, M.G., SCATOLINO, M.V., LIMA, M.D.R., DE ASSIS, M.R., BUFALINO, L., NUMAZAWA, S.,TRUGILHO, P.F., PROTÁSIO, T.P. **Relating features and combustion behavior of biomasses from the Amazonian agroforestry chain**. Biomass Conversion and Biorefinery. 2020. DOI: 10.1007/s13399-020-01121-1.

DIAS, Y.N., SOUZA, E.S., DA COSTA, H.S.C., MELO, L.C.A., PENIDO, E.S., DO AMARANTE, C.B., TEIXEIRA, O.M.M.,FERNANDES, A.R. **Biochar produced from Amazonian agro-industrial wastes**: properties and adsorbent potential of Cd2+ and Cu2+. Biochar, V 1 (4), pp. 389-400, 2019. DOI: 10.1007/s42773-019-00031-4.

ERLACHER, W. A.; OLIVEIRA, F. L.; SILVA, D. M. N. ; QUARESMA, M. A. L.; CHRISTO, B. F. **Produção de mudas de hortaliças de fruto a partir de substratos formulados com caroço de açaí**. Cadernos de Agroecologia, v. 8, n. 2, p. 1 - 5, 2013.

ERLACHER, W. A.; OLIVEIRA, F. L.; SILVA, D. M. N.; QUARESMA, M. A. L.; CHRISTO, B. F. Produção de mudas de hortaliças em substratos à base de caroço de açaí. **Revista Brasileira de Agroecologia**, v. 11, n. 4, 2016.

ERLACHER,b W. A.; OLIVEIRA, F. L.; SILVA, D. M. N.; QUARESMA, M. A. L.; SANTOS, D. A.; CHRISTO, B. F., MENDES, T. P. Uso de Caroço de Açaí Triturado Fermentado para a Formulação de Substratos para Produção de Mudas de Quiabo e Tomate. **Revista Brasileira de Agropecuária Sustentável**, v. 4, n. 2, 2014.

ERLACHERa, W. A.; OLIVEIRA, F. L.; SILVA, D. M. N.; QUARESMA, M. A. L.; CHRISTO, B. F. **Caroço de açaí triturado fresco na formulação de substrato para a produção de mudas de hortaliças brássicas**. Centro Científico Conhecer, Enciclopédia Biosfera, v. 10, n.8, p. 2930 – 2940, 2014.

FERREIRA, S.F., BULLER, L.S., MACIEL-SILVA, F.W., SGANZERLA, W.G., BERNI, M.D., FORSTER-CARNEIRO, T. **Waste management and bioenergy recovery from açaí processing in the Brazilian Amazonian region: a perspectivefor a circular economy**. Biofuels, Bioproducts and Biorefining , V 15 (1), pp. 37-46, 2021. DOI: 10.1002/bbb.2147.

FONSECA, T. R. B.; BARRONCAS, J. F.; TEIXEIRA, M. F. S. Produção em matriz sólida e caracterização parcial das proteases de cogumelo comestível da Floresta Amazônica. **Revista Brasileira de Tecnologia Agroindustrial**, v. 8, n. 1, 2014.

FRAGOSO, A. C. M.; ALCÂNTARA, L. V.; SILVA, C. P. G.; ARAÚJO, V. E. S.; SOUZA, M. J. R. **Minimização de impactos ambientais causados pelos caroços de açaí: o caso Telha Forte**. In: Anais do 4º Congresso Internacional de Tecnologias para o Meio Ambiente. Bento Gonçalves, 2014. https://siambiental.ucs.br/congresso/index.php/anais/trabalhosTecnicos?ano=2014. (Accessed April 11, 2017).

GARCIA, S. F.; OLIVEIRA, C.; SILVA, B. M. S. **Emergência de Plântulas de Tabebuia Caraiba** (Mart.) Bureau. Ciência Rural, v. 42, n. 8, p. 1419 - 1422, 2012.

GOES, R. O.; MORENO, S. O.; TAVARES, F. F. C. **Produção e Avaliação das Propriedades Físicas e Mecânicas de "Madeira Sintética" Processada a partir do Resíduo do Beneficiamento do Açai**. Blucher Chemical Engineering Proceedings, v. 1, n. 2, p. 13199 - 13204, 2014.

GOMES, D. I.; VÉRAS, R. M. L.; ALVES, K. S.; DETMANN, E.; OLIVEIRA, L. R. S.; MEZZOMO, R.; SANTOS, R. B.; SOUSA BARCELOS, S. **Performance and digestibility of growing sheep fed with acai seed meal-based diets**. Tropical Animal Health and Production, v. 44, n. 7, p. 1751 - 1757, 2012.

GONÇALVES JÚNIOR., A. C.; COELHO, G. F.; SCHWANTES, D.; RECH, A. L.; CAMPAGNOLO, M. A., MIOLA, A. J. **Biosorpion of Cu (II) and Zn (II) with açaí endocarp Euterpe oleracea M. in contaminated aqueous solution**. Acta Scientiarum Technology, v. 38, n. 3, p. 361 - 370, 2016.

GONÇALVES, A.C., JR., SCHWANTES, D., CAMPAGNOLO, M.A., DRAGUNSKI, D.C., TARLEY, C.R.T., DOS SANTOS SILVA, A.K. **Removal of toxic metals using endocarp of açaí berry as biosorbent**. Water Science and Technology. V 77 (6), pp. 1547-1557, 2018. DOI: 10.2166/wst.2018.032.

GONCALVES, AC; SCHWANTES, D; CONRADI, E; ZIMMERMANN, J; COELHO, GF. **Adsorption of Cd (II), Pb (II) and Cr (III) on chemically modified Euterpe Oleracea biomass**

for the remediation of water pollution. ACTA SCIENTIARUM-TECHNOLOGY . V. 43, 2021. DOI: 10.4025/actascitechnol.v43i1.50263.

GONÇALVES, D. C. M.; GAMA, J. R. V.; OLIVEIRA, F. A.; OLIVEIRA JR, R. C.; ARAÚJO, G. C. A., & ALMEIDA, L. S. **Aspectos mercadológicos dos produtos não madeireiros na economia de Santarém-Pará**, Brasil. Floresta e Ambiente, v. 19, n. 1, p. 9 - 16, 2012.

GONÇALVES, G. M. S.; SANTOS, N. P.; SREBERNICH, S. M. Antioxidant and antimicrobial activities of propolis and açai (Euterpe oleracea Mart) extracts. **Revista de Ciências Farmacêuticas Básica e Aplicad**a, vol. 32, n. 3, 2011. http://serv-bib.fcfar.unesp.br/seer/index.php/Cien_Farm/article/viewArticle/1728. (Accessed January 13, 2017).

GONÇALVES, R. F. B.; SILVA, M. O. GUERRA, D. R. S.; NOGUEIRA M. F. M. **Evaluation of briquettes made from amazonian biomass waste**. In: WASTES 2015 - Solutions, Treatments and Opportunities: Selected papers from the 3rd Edition of the International Conference on Wastes: Solutions, Treatments and Opportunities, Viana Do Castelo, Portugal, 14-16 September 2015. CRC Press, 2015. p. 103.

GUEDES, RS; PINTO, DA; RAMOS, SJ; DIAS, YN; CALDEIRA, CF; GASTAUER, M; SOUZA, PWME; FERNANDES, AR. Biochar and conventional compost reduce hysteresis and increase phosphorus desorbability in iron mining waste. **Revista Brasileira de Ciência do Solo**. V 45, 2021 . DOI: 10.36783/18069657rbcs20200174.

ITAI, Y.; SANTOS, R.; BRANQUINHO, M.; MALICO, I.; GHESTI, G. F.; BR, A. M. Numerical and experimental assessment of a downdraft gasifier for electric power in Amazon using acai seed (Euterpe oleracea Mart.) as a fuel. **Renewable Energy**, v. 66, p. 662 - 669, 2014.

KÜHL, R. M.; OLIVEIRA, G., MUNIZ, R., ROCHA, B., & SÁ, J. **Avaliação de sistemas alternativos para geração de energia elétrica e térmica**: um estudo de caso no restaurante universitário da Universidade Federal Rural da Amazônia (UFRA)–PA. In: Anais do IV Congresso Interamericano de Resíduos Sólidos da Associação Interamericana de Engenharia Sanitária e Ambiental. El Salvador. San Salvador. 06p. 2014.

LEÃO, J. R. A.; PAIVA, A. V.; LIMA, J. P. C. **Resíduos agroflorestais utilizados na germinação e desenvolvimento de mudas de angelim-doce**. Biotemas, v. 26, n. 1, p. 25 - 35, 2012.

LEÃO, J. R.; LIMA, J. P. D. C.; PINTO, S. D. N., & PAIVA, A. V. Germinação de Sementes e Crescimento Inicial de Plântulas de Ingá-Mirim, Inga laurina (S W.) Willd utilizada na Arborização Urbana de Rio Branco, Acre. **REVSBAU**, v. 7, n. 3, p. 10-17, Piracicaba, São Paulo, 2012.

LEITE, P. R., Logística Reversa: Meio Ambiente e Competitividade, ed. 2, São Paulo: Prentice Hall, 2003.

LIAMSANGUAN, C.; GHEEWALA, S. H. LCA: A decision support tool for environmental assessment of MSW management systems, **Journal of Environmental Management,** v.87, n.1, p. 132 – 138, 2008.

LIMA JUNIOR, A. S. **A escola no contexto das tecnologias de comunicação e informação**: do dialético ao virtual. Salvador: EDUNEB, 2007.

LIMA, H.; CORREA, N. C. F.; SANTOS, O.; LOURENÇO, L. D. F. H. Use of agroindustrial wastes (acai fiber and glycerol) in the preparation of cookies. **Journal of food science and technology**, v. 52, n. 7, p. 4593 - 4599, 2015.

LUCZYNSKI, M. ; MACHADO, L. C. G. T.; PADILHA, J.; RENDEIRO, G.; MACEDO, E. N. **Viabilidade Econômica da Utilização da Semente de Euterpe oleracea Mart. (Açaí) como Recurso Energético**. Biomassa & Energia, v. 4, n. 2, p. 149 - 162, 2011.

MACIEL-SILVA, FW; MUSSATTO, SI; FORSTER-CARNEIRO, T. Integration of subcritical water pretreatment and anaerobic digestion technologies for valorization of acai processing industries residues. **Journal of Cleaner Production**. V. 228, P. 1131-1142, 2019 DOI: 10.1016/j.jclepro.2019.04.362.

MANCINI, M. C; SAMPAIO, R. F. Quando o objeto de estudo é a literatura: estudos de revisão (Editorial). **Brazilian Journal of Physical Therapy**, v. 10, n. 4, São Carlos, 2006.

MARANHO, A. S.; PAIVA, A. V. Emergência de plântulas de Pourouma guianensis Aubl. (Urticaceae) em função do substrato-DOI: 10.5039/agraria. v7isa1942. Revista Brasileira de Ciências Agrárias (Agrária) **Brazilian Journal of Agricultural Sciences**, v. 7, p. 844 - 849, 2012.

MARANHO, A. S.; PAIVA, A. V. Crescimento inicial de mudas de Senna silvestris (Vell.) HS Irwin & Barneby cultivadas em diferentes substratos. **REVSBAU**, Piracicaba–SP, v. 6, n. 4, p. 1 - 14, 2011.

MARANHO, A. S.; PAIVA, A. V.; PAULA, S. R. P. Crescimento inicial de espécies nativas com potencial madeireiro na Amazônia, BR. **Revista Árvore**, v. 37, n. 5, p. 913 - 921, 2013.

MARANHOa, A. S.; PAIVA, Ary Vieira de. Emergência de plântulas de Supiarana (Alchornea discolor Poepp.) em substrato composto por diferentes porcentagens de resíduo orgânico de Açaí. **Revista da Sociedade Brasileira de Arborização Urbana**, Piracicaba, v. 6, n. 1, p. 85 - 98, 2011.

MARANHOb, A. S.; PAIVA, A. V. **Produção de mudas de Physocalymma scaberrimum em substratos compostos por diferentes porcentagens de resíduo orgânico de açaí**. Floresta, v. 42, n. 2, p. 399 - 408, 2012.

MARES, E.K.L., GONÇALVES, M.A., DA LUZ, P.T.S., DA ROCHA FILHO, G.N., ZAMIAN, J.R., DA CONCEIÇÃO, L.R.V. **Acai seed ash as a novel basic heterogeneous catalyst for biodiesel synthesis**: Optimization of the biodieselproduction process. Fuel. V 299, 2021. DOI: 10.1016/j.fuel.2021.120887.

MARTINS, GR; DO AMARAL, FRL; BRUM, FL; MOHANA-BORGES, R; DE MOURA, SST; FERREIRA, FA; SANGENITO, LS; SANTOS, ALS.; FIGUEIREDO, NG.; DA SILVA, AS. **Chemical characterization, antioxidant and antimicrobial activities of acai seed (Euterpe oleracea Mart.) extracts containing A- and B-type procyanidins**. LWT-FOOD SCIENCE AND TECHNOLOGY. V 132, 2020. DOI: 10.1016/j.lwt.2020.109830.

MARTINS, L.S., SILVA, N.G.S., CLARO, A.M., AMARAL, N.C., BARUD, H.S., MULINARI, D.R. Insight on açaí seed biomass economy and waste cooking oil: Eco-sorbent castor oil-based. **Journal of Environmental Management**. V 93, 2021. DOI: 10.1016/j.jenvman.2021.112803.

MARVILA, MT; AZEVEDO, ARG; CECCHIN, D; COSTA, JM; XAVIER, GC; DO CARMO, DD; MONTEIRO, SN. **Durability of coating mortars containing acai fibers**. Case studies in construction materials. V 13, 2020. DOI: 10.1016/j.cscm.2020.e00406.

MELO, P. S.; ARRIVETTI, L. D. O. R.; ALENCAR, S. M., & SKIBSTED, L. H. **Antioxidative and prooxidative effects in food lipids and synergism with α-tocopherol of açaí seed extracts and grape rachis extracts**. Food Chemistry, v. 213, p. 440 - 449, 2016.

MESQUITA, A. L., BARRERO, N.G., FIORELLI, J., CHRISTOFORO, A.L., DE FARIA, L.J.G., LAHR, F.A.R. **Eco-particleboard manufactured from chemically treated fibrous vascular tissue of acai (Euterpe oleracea Mart.) Fruit: A new alternative for the particleboard industry with its potential application in civil construction and furniture**. Industrial Crops and Products. V 112, pp. 644-651, 2018. DOI: 10.1016/j.indcrop.2017.12.074.

MONTEIRO, G.P., DE AZEVEDO, A.R.G., MARVILA, M.T. **Effect of the addition of the natural and treated açaí stone in structural mortars**. AIMS Materials Science. V 8 (4), pp. 608-621, 2021. DOI: 0.3934/matersci.2021037.

MUNIZ, R. N., & ROCHA, B. **Gaseificação de biomassa residuária na Amazônia**: estudo de caso em comunidade quilombola no Pará. Anais do, v. 8. In: Anais do 8° Congresso Internacional de Bioenergia. SÃO PAULO – SP, 2013.

NAGATA, GA ; SOUTO, BA ; PERAZZINI, MTB ; PERAZZINI, H. **Analysis of the isothermal condition in drying of acai berry residues for biomass application**. BIOMASS & BIOENERGY. V 133, 2020.DOI: 10.1016/j.biombioe.2019.105453.

NASCIMENTO, B.F., DE ARAUJO, C.M.B., DO NASCIMENTO, A.C., DA SILVA, F.L.H., DE MELO, D.J.N., JAGUARIBE, E.F., LIMA CAVALCANTI, J.V.F., DA MOTTA SOBRINHO, M.A. Detoxification of sisal bagasse hydrolysate using activated carbon produced from the gasification of açaí waste. **Journal of Hazardous Materials**. V 409, 2021. DOI: 10.1016/j.jhazmat.2020.124494.

NASCIMENTO, V. H. N. D.; LIMA, C. D. S.; PAIXÃO, J. T. C. FREITAS, J. J. D. S.; KIETZER, K. S. **Antioxidant effects of acai seed (Euterpe oleracea) in anorexia-cachexia syndrome induced by Walker-256 tumor**. Acta Cirurgica Brasileira, v. 31, n. 9, p. 597 - 601, 2016.

NEGRÃO, L. L. L; GODINHO FILHO, M.; MARODIN, G. **Lean Practices and Their Effect on Performance**: A literature review. Production Planning & Control, v. 28, n. 1, p. 33 - 56, October, 2016. DOI: 10.1080/09537287.2016.1231853.

NEU, V.; SANTOS, M. A. S.; MEYER, L. F. F.; CARMO, F. D. S. C., & CRUZ, M. S. Resgate da sociobiodiversidade: restauração ambiental com geração de renda em comunidades ribeirinhas na Amazônia Oriental. **Revista Ciência em Extensão**, v. 12, n. 3, p. 164 - 177, 2016.

OLIVEIRA, D.N.P.S., CLARO, P.I.C., DE FREITAS, R.R., MARTINS, M.A., SOUZA, T.M., DA S. E SILVA, B.M., MENDES, L.M., BUFALINO, L. **Enhancement of the Amazonian Açaí Waste Fibers through Variations of Alkali Pretreatment Parameters**. Chemistry and Biodiversity. V 16 (9), 2019. DOI: 10.1002/cbdv.201900275.

OLIVEIRA, O. M.; HERRERA, R. C.; PARRY, M. M.; OLIVEIRA, G. M.; HERRERA, J. A., &

SANTOS, A. P. F. **Espécies botânicas utilizadas no artesanato comercializado na cidade de Altamira-PA**. Biota Amazônia (Biote Amazonie, Biota Amazonia, Amazonian Biota), v. 4, n. 4, p. 1 - 5, 2014.

PAULA, S. R. P.; PAIVA, A. V.; MARANHO, Á. S. **Transposição de plântulas de Alchornea castaneifolia (Willd.) A. Juss. da regeneração natural como estratégia de produção de mudas em viveiro**. Cerne, v. 19, n. 2, p. 323 - 330, 2013. http://dx.doi.org/10.1590/S0104-77602013000200017. (Accessed April 11, 2017).

PEREIRA, S. D. F. P.; MACIEL, A. E. S.; SANTOS, D. C.; MARES, E. K. L.; OLIVEIRA, G. R.; BITTENCOURT, J. A., & OLIVEIRA, J. S. PEREIRA. **Remoção de Metais de Águas Superficiais usando Carvão Vegetal de Açai (Euterpe Oleracea Mart)**. In: Proceedings of International Conference on Engineering and Technology Education. p. 401 - 405. 2014.

PESSÔA, T.S., LIMA FERREIRA, L.E.D., DA SILVA, M.P., PEREIRA NETO, L.M., NASCIMENTO, B.F.D., FRAGA, T.J.M., JAGUARIBE, E.F., CAVALCANTI, J.V., DA MOTTA SOBRINHO, M.A. Açaí waste beneficing by gasification process and its employment in the treatment of synthetic and raw textilewastewater. **Journal of Cleaner Production**, V 240, 2019. DOI: 10.1016/j.jclepro.2019.118047.

PINSKY, V. C.; DIAS, J. L.; KRUGLIANSKAS, I. Gestão estratégica da sustentatibilidade e inovação. **Revista de Administração da UFSM**, v. 6, n. 3, p. 465 - 480, 2013.

PIRES, E. S.; SOUZA, F. C. A.; OLIVEIRA, P. C. R.; SOARES, A. S.; SOUZA, J. A. M.; CORDEIRO, R. A. M. **Produção de matéria seca e avaliação de mudas de quiabeiro em diferentes tipos de substratos**. In: VII CONNEPI-Congresso Norte Nordeste de Pesquisa e Inovação. 2012.

QUEIROZ, L.S., DE SOUZA, L.K.C., THOMAZ, K.T.C., LEITE LIMA, E.T., DA ROCHA FILHO, G.N., DO NASCIMENTO, L.A.S.,DE OLIVEIRA PIRES, L.H., FAIAL, K.D.C.F., DA COSTA, C.E.F.Activated carbon obtained from amazonian biomass tailings (acai seed): Modification, characterization, and use forremoval of metal ions from water. **Journal of Environmental Management** ,V 270, 2020. DOI:10.1016/j.jenvman.2020.110868.

RAMBO, M. K. D.; SCHMIDT, F. L.; FERREIRA, M. M. C. **Analysis of the lignocellulosic components of biomass residues for biorefinery opportunities**. Talanta, v. 144, p. 696-703, 2015.

REIS, JS ; ARAUJO, RO; LIMA, VMR; QUEIROZ, LS; DA COSTA, CEF; PARDAUIL, JJR; CHAAR, JS; ROCHA, GN; DE SOUZA, LKC. Combustion properties of potential Amazon biomass waste for use as fuel. **Journal of Thermal Analysis and Calorimetry**. V. 138 ,(5)P. 3535-3539, 2019. DOI: 10.1007/s10973-019-08457-5.

ROCHA, D.L. , AZEVEDO, A.R.G., MARVILA, M.T., CECCHIN, D., ALEXANDRE, J., CARMO, D.F., FERRAZ, P.F.P., CONTI, L.,ROSSI, G. **Influence of different methods of treating natural açai fibre for mortar in rural construction**. Agronomy Research, V 19, pp. 910-921, 2021. DOI: 10.15159/AR.21.062.

RODRIGUES, J. C. W.; PEREIRA, C. E.; PAES, L. F.; SANTOS, J. C. N., & BORDINHON, A. M. **Utilização de Resíduos Agrícolas na Produção de Mudas de Rúcula (Eruca sativa) e**

Alface (Lactuca sativa). Cadernos de Agroecologia, v. 11, n. 2, 2016.

ROMANI, V.P., MARTINS, V.G., DA SILVA, A.S., MARTINS, P.C., NOGUEIRA, D., CARBONERA, N. Amazon-sustainable-flour from açaí seeds added to starch films to develop biopolymers for active food packaging. **Journal of Applied Polymer Science**. 2021. DOI: 10.1002/app.51579.

SAGRI - Secretaria de Estado de Agricultura (2010). **Produção agrícola do estado do Pará**. http://www.sagri.gov.br/SIMA . (Accessed September 08, 2016).

SALES-CAMPOS, C ; DA SILVA, JF; DO NASCIMENTO, LBD; GOUVEA, PRD; DE AGUIAR, LVB; FARINA, JI; PONTES, GS; CHEVREUIL, LR. Nutritional and Bioactive Properties of an Amazon Wild Oyster Culinary-Medicinal Mushroom, Pleurotus ostreatus (Agaricomycetes): Contributions to Functional Food and Human Health. **International Journal of Medicinal Mushrooms**. V. 23(7), Pages: 79-90, 2021.

SAMPAIO, R.; MANCINI, M. Estudos de revisão sistemática: um guia para síntese criteriosa da evidência científica. **Revista Brasileira de Fisioterapia**, vol. 11, no. 1, pp. 83–39, 2007. http://bases.bireme.br/cgi-in/wxislind.exe/iah/online/?IsisScript=iah/iah.