



RESEARCH ARTICLE

OPEN ACCESS

## WASTE FROM PRUNING OF AZADIRACHTA INDICA: LITERATURE REVIEW

**<sup>1</sup>Luiz Antonio Alves Fernandes, <sup>2</sup>José Gorete Pedroza de Lacerda; <sup>2</sup>Fernando Antonio Portela da Cunha; <sup>3</sup>Egle Katarinne Souza da Silva; <sup>3</sup>Maria Alcantara dos Santos; <sup>2</sup>Edilson Leite da Silva; <sup>2</sup>Everton Vieira da Silva; <sup>1</sup>Danilo Abrantes de Oliveira and <sup>5</sup>Neliane Dias de Souza**

<sup>1</sup>Graduate in Chemistry, Federal University of Campina Grande, Cajazeiras, Paraíba, Brazil

<sup>2</sup>Teacher in Teacher Training Center, Federal University of Campina Grande, Cajazeiras, Paraíba, Brazil

<sup>4</sup>Post-graduate Program in Agroindustrial Systems, Federal University of Campina Grande, Pombal, Paraíba, Brazil

<sup>5</sup>Nurse, Post-graduate Program in Agroindustrial Systems, Federal University of Campina Grande, Pombal, Paraíba, Brazil

### ARTICLE INFO

#### Article History:

Received 25<sup>th</sup> April, 2018

Received in revised form

10<sup>th</sup> May, 2018

Accepted 06<sup>th</sup> June, 2018

Published online 30<sup>th</sup> July, 2018

#### Key Words:

Azadirachta Indica,  
Solid waste,  
Briquette.

### ABSTRACT

The Azadirachta Indica is a plant of the Meliaceae family, species originating in Southeast Asia and the Indian subcontinent, commonly used in several Brazilian municipalities for afforestation. The rising generation of municipal waste requires that there are alternatives to circumvent/minimize environmental problems. One of the possibilities to circumvent this problem is the reuse of solid waste from the pruning of trees as biomass for power generation, where through the briquetting, you can compress the waste and transform them into a renewable energy source. It developed the present bibliographical research with the objective of analyzing in official documents, books, theses, dissertations, in addition to articles published in scientific journals, in the interval of time 1983-2018, the concepts of the Azadirachta Indica, for both addressed the following themes: Solid Waste, Biomass, Pruning of Trees, Azadirachta Indica and Briquettes. In the face of the information submitted, it can be said that the process of pruning of the Azadirachta Indica generates residue and the improper disposal of these causes environmental pollution, and the production of biofuel solid, in the form of briquettes, a viable alternative to the reutilization of biomass, considering a practice that encompasses three pillars: environmental, economic and social development.

Copyright © 2018, Luiz Antonio Alves Fernandes et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Citation: Luiz Antonio Alves Fernandes, José Gorete Pedroza de Lacerda; Fernando Antonio Portela da Cunha et al. 2018. "Waste from pruning of azadirachta indica: literature review", *International Journal of Development Research*, 8, (07), 21708-21712.

### INTRODUCTION

The urban development causes more damage to the environment, among many damage caused, stands the deforestation of flora, where by means of destructive actions the contemporary man possesses natural resources for their own benefit, and ends in the majority of cases, impairing the nature (NAKASHIMA, 2018). How to deforestation a palliative measure to minimize the damage caused by this action is the afforestation. As regards afforestation is known that this alternative minimizes the damage caused to the environment, but with the passing of the years, this alternative

is to represent other problems for society and/or municipal managers. The plants used for afforestation hall after reaching maturity, need specific care and pruning, however, the residue from this activity becomes, in the majority of cases, a clump of waste disposed inadequately. Therefore, the large accumulation of pruning the urban perimeter configures itself as environmental pollution and affect any living species that depends on environmentally appropriate conditions for survival (NOGUEIRA et al. 2016). Another problem related to urban forestry is the replacement of native trees by species not regional or even international, which can adapt to the local climate and present a growth and differentiated resistance, and may stand in relation to native species. In some Brazilian municipalities, there is a high concentration of species not

\*Corresponding author: Luiz Antonio Alves Fernandes

Graduate in chemistry, Federal University of Campina Grande, Cajazeiras, Paraíba, Brazil

regional, with emphasis to the Nim Indian, scientifically named as *Azadirachta Indica* plant in the *Meliaceae* family, species originating in Southeast Asia and the Indian subcontinent (MARTINEZ, 2002). Taking into account the environmental and social risks caused by the production of solid waste, from the pruning of the *Azadirachta indica*, it is necessary to have a critical look at the population in general, for the development of projects and/or actions that seek to minimize and/or exclusion of this environmental problem, since the accumulation of these wastes is configured as an appropriate location for proliferation of vectors, disseminators of various types of diseases such as dengue, leptospirosis, bubonic plague, among others (PEREIRA; ALEXIUS, 2018; DALL'AGNOL, 2017). Before the capitalist society and consumerism, currently lives become a historic period based on the minimal wastage and maximum reuse, configuring it as the era of the principle of 3Rs (Reduce, Recycle, Reuse). In this context, the pruning of the *Azadirachta Indica* can be seen as raw material for production of renewable energy, reducing in this way, the volume of this biomass residues of urban roads, becoming a profitable alternative for reuse. Trying to adapt to the appeal of the reutilization and trying to reduce the volume of waste, from the pruning of the *Azadirachta Indica* held this research from the following question: Is it possible to reuse the waste of *Azadirachta Indica* for production of briquettes?

Trying to answer this question, it developed the present bibliographical research with the objective of analyzing in official documents, books, theses, dissertations, in addition to articles published in scientific journals, in the interval of time 1983-2018, the concepts of the *Azadirachta Indica*.

## MATERIALS AND METHODS

This research is classified as literature, because it is based on documents already published for obtaining relevant information about the *Azadirachta Indica*. As highlight Lima and Miotto (2007, p. 43). The bibliographic studies are configured as a methodological procedure, "capable of generating, especially on topics little explored, the postulation of hypotheses or interpretations that will serve as a starting point for further research." The writing of the theoretical corpus of this research was based on official documents, books, theses, dissertations, in addition to articles published in scientific journals. Being this session comprised by the following subtopics: Solid Waste, Biomass, pruning of trees, *Azadirachta Indica* and Briquettes. The time interval studied comprised: 1983-2018.

## SOLID WASTE

The accumulation of urban solid waste, from the pruning of trees on public roads favors the proliferation of vectors and, consequently, cause problems of environmental, social and economic. Currently, the majority of Brazilian municipalities still discards this type of residue in controlled landfills and/or open-air dumps, contrary to the requirements of the National Policy of Solid Waste (PNRS), which places as required, since 2010, the use of landfills as final disposal of solid waste produced in urban centers. The Pnrs has about the importance of recycling of solid urban waste, stressing the energy recovery of these, so that there is technical feasibility and environmental (BRAZIL, 2010). According to the Panorama of solid waste collected in Brazil in the year 2016, 71.3 million tons of solid waste compost, being intended for 58.4% or 41.7

million tonnes for landfills, and 29.7 million tonnes of waste, corresponding to 41.6% of the collected, to dumps or landfills controlled (ABRELPE, 2017). These data confirm the default of most Brazilian municipalities outside the adequacy of the final disposal of solid waste in landfills.

The Law 12,305 of August of 2010 establishing the National Solid Waste Policy defines Solid Waste as being either:

Material, substance, object or well disposed resulting from human activities in society, whose final destination is dissolved, if intends or is obliged, in solid or semi-solid, as well as gases contained in containers and liquid whose particularities render impractical its launch in public sewers or into water bodies, or require for this technical solutions or economically unviable in the face of best available technology (BRAZIL, 2010, p.11).

In the technical and legal aspect, the Brazilian Association of Technical Standards (ABNT), through the NBR 10.004/04 (ABNT, 2004), defines the solid waste more broadly:

Solid waste in the United And semisólido, resulting from the activities of industrial origin, domestic, hospital, commercial, agricultural, services and sweeping. Are Included in this definition the sludges from water treatment systems, those generated in equipment and plant for pollution control, as well as certain liquids whose particularities render impractical its launch in public sewers or bodies of water, or require for this technical solutions and economically unviable in the face of the best available technology (ABNT, 2004). As their characteristics, the solid waste are divided into classes: Class I - Hazardous Waste (presents characteristics of Ignitability, corrosivity, reactivity, toxicity and pathogenicity); Class II - non-hazardous waste; waste Class II A - non inerts (presents properties such as biodegradability combustibility, or solubility in water); Class II B - Inerts (are those which, when subjected to tests of solubilization, do not have any of their constituents dissolved in concentrations exceeding the standards of Potability of the water) (ABNT, 2004). According to pnrs, the tailings can be defined as "solid waste that, after having exhausted all the possibilities of treatment and recovery by technological processes available and economically viable, they do not present another possibility that the final disposition environmentally appropriate". (BRAZIL, 2010). The most viable alternative for the final disposition of the tailings dam is the landfill, which consists in the compaction of these residues in layers, where the soil is waterproofed and slurry is channeled and treated, avoiding the contamination of underground water resources. (SILVA; FIGUEIREDO E SILVA, 2017). On the environmentally sound disposal of waste, the Portal of Solid Waste (PRS) says that the "final disposition obligatorily should have protection from air and soil, as well as treatment of slurry and gas from the landfill" (PRS, 2018). Also, on the final destination suitable for the solid waste, the PNRS on your Art. 3º emphasizes that this process should include the reuse, recycling, composting, recovery and energy or other destinations admitted by the competent bodies. (BRAZIL, 2010).

## BIOMASS

Among the various types of solid waste that can receive a new treatment and return to the productive chain, consequently reducing the negative environmental, social and economic that

the improper disposal of these causes, one has the biomass. For energy purposes biomass is any organic mass that can be used as fuel or for its production. According to the National Electric Energy Agency (ANEEL) the term Biomass comprises:

All renewable resource come from organic matter (of animal or vegetable origin) which can be used in the production of energy. As well as the hydraulic energy and other renewable sources, biomass is an indirect form of solar energy. Solar energy is converted into chemical energy through photosynthesis, the basis of the biological processes of all living beings. (ANEEL, 2005 p. 77).

For the Ministry of Mines and Energy (MME) the term biomass:

Understands the vegetable matter generated by photosynthesis and its various products and by-products, such as forests, crops and agricultural waste, animal waste and organic matter that is contained in industrial and urban wastes. This field contains the chemical energy accumulated through the conversion efficiency of solar radiation and can be directly released through the combustion, or be converted through different processes in energy products of different nature, such as: charcoal, ethanol, combustible gases and synthesis, vegetable oils and other fuels (BRASIL, 2007 p. 103). The calorific potential of biomass can be leveraged through its compression, with this the reuse of urban solid waste converted into biomass can add numerous beneficial effects for society. The transformation of biomass produces different types of energy, such as thermal, electrical, and mechanical. In the thermal energy of the direct combustion systems can be used in cooking, heating and drying. The electrical energy is obtained through the transformation of biomass from energy crops and industrial waste and the mechanics is resulting from the use of biofuels, which allow you to replace, total or partially, the fossil fuels (CORTEZ; LORA; GÓMEZ, 2008). The compaction of coal materials leverages its reuse in the production of energy, because with the compression of biomass in the form of pellets in addition to reduce environmental impacts (caused by the accumulation of organic matter in inappropriate places), releasing a high content of energy through its burning.

## PRUNING OF TREES

The production of solid waste in cities is being exacerbated increasingly in the contemporary period, with increasing urbanization is necessary to increase the amount of ecological areas within cities to control the content of CO<sub>2</sub>, with this afforestation is needed (MEIRA, 2010). On the origin of waste from pruning, Meira (2010, p. 43) explains "[...] are derived from pruning of cleaning and maintenance of urban arborization; as a result of falls by natural phenomena (windstorms) and senescence, or even by human depredation." Regarding the chemical composition, the residues from pruning are organic materials, and their chemical constituents are directly related to their properties, being composed of 50% of carbon, 6% hydrogen, 44% oxygen and 1% ofogênio Nitr (BARRICHELO; BRITO, 1985; Silva *et al.*, 2005; MERIRA, 2010). Along with the afforestation, it is necessary to control the trees, one of them is the esthetic treatment and physiological effect of trees which is pruning. This technique refers to the partial withdrawal of branches of the plant, which modifies its structure and consequently its state of

development. According to the Secretariat of Green and Environment of the municipality of São Paulo (SVMA) is essential to perform the pruning of trees, because it eliminates the dead branches, damaged, diseased or praguejados; removes the parts of the tree that put at risk the safety of persons; and draws the parties that interfere or cause unavoidable damage to buildings or equipment urban (SVMA, 2005).As regards the advantages of the process of pruning of trees, stand out: "Avoid accidents involving the electrical network in urban areas; reduce the risk of falling branches on the pedestrians; Increase the efficiency of public lighting; allow the harmony between the plant and the environment where it is being cultivated." (NOGUEIRA *et al.*, 2016, p.13).Through the process of pruning, is an aggravating factor, as the concentration of these residues from pruning, on public roads, after being made the collections of the pruning of trees, these are arranged in the same location as the other solid urban waste, without a minimum of treatment. Faced with this reality comes the need for the development of studies that allow the environmentally appropriate final disposal of such waste.

## Azadirachta Indica

According to the literature the *Azadirachta indica* is not a natural plant in the brazilian biome, *Azadirachta indica* came from India and has adapted very well to the dry weather in the northeast region, currently, one of the predominant trees for planting in several Brazilian cities, because it does not require as much regularity in the supply of water, the *Azadirachta Indica* grows very fast compared to the growth of other species (MORGAN, 2009; BISWAS, *et al.* 2002). As for the characteristics of the wood of *Azadirachta indica*, studies de Araújo (1999) identified the specific mass of the Nim of 0.57 g/cm<sup>3</sup>. Koul, Isman And ketkar (1990) stated that the wood of Nim has specific mass between 0.56 and 0.85 g/cm<sup>3</sup>, with an average of approximately 0.70 g/cm<sup>3</sup>. Already in 2002 different studies allowed us to identify, in India, the value of 0.80 g/cm<sup>3</sup> for wood of neem (ARAUJO, 1999; KOUL, ISMAN and KETKAR, 1990; BISWAS *et al.*, 2002). The *Azadirachta indica*, by presenting several biologically active compounds, has been used as a raw material in various areas of pharmaceutical, agrochemical, and agro (MORGAN, 2009). Features functions of natural antibiotic, antifungal, antiviral and antiparasitic and, in some regions, the Caribbean, for example, is used as an ornamental plant, was also identified their use as pest repellent and feed for livestock (PIETROSEMOLI *et al.* 1999). The research developed by Martinez (2002) point out the Nim as medicinal plant, can be used in the cure of diabetes, the treatment of dermatological problems, malaria, can still be used as antiseptic, tonic, vermifuge and in combating the scab, fleas and other diseases. In India the Nim is used for more than 200 years in various sectors, namely:

[...] control of insect pests (whitefly, caused, brasileiro, tick, caterpillars and stored grain pests) nematodes, some fungi, bacteria and viruses in human and animal medicine, in the manufacture of cosmetic, reforestation, such as hardwood, manure, as well as landscaping. (NEVES; OLIVEIRA; NOGUEIRA, 2003, p.02). In spite of the *Azadirachta indica* is being used in various fields of research, before a prospective study in databases of patents: European Patents Office (EPO); patents from Latin America and Spain (LATIPAT); World Intellectual Property Organization (WIPO) and in the United States Patent and Trademark Office (USPTO) and the National

Institute of Industrial Property (INPI), we identified no studies on the use of this tree pruning for the production of energy. Therefore, it can be argued that the use of biomass of *Azadirachta indica* for production of briquettes, through the process of compression is something innovative and promising for future research and laboratory practices.

### Briquettes

The compaction of biomass for energy production can be characterized as a sustainable solution to the excess of the volumes of waste in cities. The compaction condenses large volumes of waste in small and adaptable blocks with an excellent calorific potential. Second Quirino (2004), any residue of vegetable origin can be transformed into briquettes, the compaction process, provided that they meet the needs of particle size and moisture content required by the process. According to Quirino (2004), the briquette is the end product of the densification of residue of vegetable origin, by presenting promising characteristics is a great Substituent of firewood, in this sense can be regarded as ecological wood. The high calorific potential of the briquette makes it an excellent substitute for fossil fuels for power generation in boilers, in industries, such as coal, and/or to be used in ovens in potteries, pizzerias and fireplaces by replacing the use of firewood, with the aspect of being a renewable energy resource of quality (QUIRINO, 2004; OSHIRO, 2016). The production of briquettes can, in the short and long term, be regarded as a sustainable outlet for the improper disposal of waste/biomass coming from pruning of trees, in landfills and/or open-air dumps. With the process of briquetting huge piles of waste can become small objects with an electronic potential of excellent quality. For oshiro (2016, p.27) "The briquettes can be used in pizzerias, bakeries, hotels, potteries, dairy industry, plaster, among other commercial and industrial installations that use furnaces. In addition, the charcoal briquettes can be done". Before the analyzes of databases (INPI, WIPO, SPACENET, LATIPAT and USPTO) and the Biomasses most used for production of pellets are wood chips, sawdust, bagasse from sugar cane straw, corn, soybeans, rice, sunflower) as far as the durices, residues of coal, pruning of trees, wood, clusters of dried leaves, goma of polyurethane, among others. Before such information, it can be argued that although there is no record of a patent on the production of briquettes from the use of biomass derived from the processing of pruning of the *Azadirachta indica*, this study is made possible by their own concession of patents, when they say that researchers have used pruning of trees for the production of briquettes, therefore, intrinsic way believes that because of the residue of pruning becomes feasible to reuse for energy production.

### Final Considerations

In the face of the information presented in this study, it can be said that the process of compresses the pruning of *Azadirachta Indica*, which offers solid biofuel as its end product (briquettes) can be a viable alternative for reuse of biomass, thereby reducing the amount of waste disposed of improperly. In view of the environmental aspects for the reutilization of pruning of *Azadirachta indica* can be cited as improvements: reducing the accumulation of urban waste; conservation of the urban environment in the housekeeping issues and structural aspects; sustainable destination for green waste from pruning and production of energy from renewable and quality. The correct management of municipal waste from pruning can

generate benefits, too, in the economic sector, since the reuse of this material for energy purposes may give rise to the creation of cooperatives for processing of residues occurring employment and income generation. The research seeks to sensitize the public administrators on environmental issues, health and aesthetics of the city. In the contemporary period there are no margins for palliative actions in favor of the environment, because environmental issues must be dealt with in a preventive way. In this context, we believe that, with the aid of government incentives, which would be a social problem can become a source of energy with consequent generation of income.

### REFERENCES

- Abnt - Brazilian Association of Technical Norms. NBR 7993:1983 Madeira - Determination of moisture by drying in an oven reduced to sawdust. Rio de Janeiro, 1983.
- Abnt - Brazilian Association of Technical Norms. NBR 10.004/2004: SolidWaste. Rio de Janeiro, 2004.
- Abrelpe. The Brazilian Association of Public cleaning companies and special waste Panorama of solid waste in Brazil 2016. 2017. Available at: <<http://www.abrelpe.org.br/Panorama/panorama2016.pdf>>. Accessed on: 16 feb. 2018.
- Aneel. Agência Nacional de Energia Elétrica. Biomass. Atlas of electrical energy. 2 ed. Brasília., 2005.
- Araújo, L. C. V. silvicultural characteristics and potential use of Moringa Moringa species (oleifera Lam.) and neem (*Azadirachta indica* A. Juss): An alternative to the semi-arid region of Paraíba state. Piracicaba, 1999. Dissertation (Master of Science in Forest Sciences). "Escola Superior de Agricultura Luis de Queiroz" - ESALQ - University of São Paulo.
- Araújo, L. V. C., Rodriguez, L.C., Paes, J. B. Physico-chemical and energy of wood from Indian neem. *Scientia Forestalis*. 57, p. 153-159, jun. 2000. Available at: <<http://www.ipef.br/publicacoes/scientia/nr57/cap11.pdf>> Access in: 06 nov. 2018.
- Barrichelo, L.E.G., Brito, M.L. Wood Chemistry. Piracicaba: ESALQ, 1985.
- Biswas K. *et al.* Biological activities and medicinal properties of neem (*Azadirachta indica*). *Current Science*, v. 82, n.11, p. 1336-1345. 2002.
- Brazil. Law 12,305, of 02/08/2010. National Solid Waste Policy. Brasilia, 2010. Available at: <[http://www.planalto.gov.br/ccivil\\_03/\\_ato2007-2010/2010/lei/112305.htm](http://www.planalto.gov.br/ccivil_03/_ato2007-2010/2010/lei/112305.htm)>. Accessed on: 16 mar. 2018.
- Brazil. Ministry of Mines and Energy. The National Energy Plan 2030. Collaboration Energy Research Company. Brasilia: MME: EPE, 2007.
- Cortez, L. A. B., Lora, E. E. Gómez, E. O. Biomass for energy. Campinas, SP: Editora da Unicamp, 2008.
- Dall'agnol, A. L. B. incidence of diseases related to Environmental Sanitation Inadequate (DRSAI) and indicators of sanitation in regions south and Campaign. Academic Work submitted in the course of Environmental and Sanitary Engineering, Universidade Federal de Pelotas, Pelotas, 2017.
- EPO. European Patent Office. Available at: <[https://worldwide.espacenet.com/advancedSearch?locale=en\\_EP](https://worldwide.espacenet.com/advancedSearch?locale=en_EP)> access on 11 Jul. 2018.
- IBGE - Brazilian Institute of Geography and Statistics. Population Count. 2010. Available at: <<https://cidades>>.

- ibge.gov.br/brasil/pb/cajazeiras/ panorama>. Accessed on: 1 -Jun. 2018.
- INPI. The National Institute of Industrial Property. Available at: <<http://www.inpi.gov.br>>. Accessed on: 10 Sep. 2018.
- Koul, O., Isman, M. B., Ketkar, C. M. properties and uses of neem, *Azadirachta indica*. Canadian Journal of Botany, Ottawa, v.68, n.1, p.1-11, 1990.
- Latipat. Patents from Latin America and Spain. Available at: <[https://lp.espacenet.com/advancedSearch? locale=pt\\_LP](https://lp.espacenet.com/advancedSearch? locale=pt_LP)>. Access in: 13 nov. 2018.
- Lima, T. C. S., Mioto, R. C. T. methodological procedures in the construction of scientific knowledge: the bibliographic research. Rev. Katál. Florianópolis v. 10 n esp. p. 37-45. 2007. Available at: <<http://www.scielo.br/pdf/rk/v10nspe/a0410spe>> Access on: 22 jun 2018.
- Martinez, S. The Nim - *Azadirachta indica* - Nature, multiple uses, production. Londrina: IAPAR, 142p, 2002.
- MEIRA, A. M. Management of waste from urban landscaping. PhD Thesis, University of São Paulo, Escola Superior de Agricultura "Luiz de Queiroz". Piracicaba, 2010.
- Morgan, D. E. *Azadirachtin*, a scientific gold mine. *Bioorganic and Medicinal Chemistry*. 2009. 17(12): 4096-4105. DOI: <http://dx.doi.org/10.1016/j.bmc.2008.11.081>
- Nakashima, G. T., briquettes produced from the use of waste from landfill of inert waste from the city of Sorocaba. *Revista Brasileira de Renewables*, v.7, N2, p. 231- 243, 2018.
- Neves, B. P., Oliveira, I. P., Nogueira, J. C. M. Cultivation and Use of Neem in India. Santo Antônio de Goiás, GO, Circular Technique of EMBRAPA. 2003. Available at: <<https://www.infoteca.cnptia.embrapa.br/bitstream/doc/212487/1/circ62.pdf>>. Access in: 27 nov. 2018.
- Nogueira, M. S. *et al.* Pruning and urban arborization. Paulo Afonso: SABEH, 2016. Available at: <[http://sabeh.org.br/wp-content/uploads/2017/06/2016\\_Livro-E-Book\\_Poda-e-Arborizac%CC%A7a%CC%83o-Urbana.pdf](http://sabeh.org.br/wp-content/uploads/2017/06/2016_Livro-E-Book_Poda-e-Arborizac%CC%A7a%CC%83o-Urbana.pdf)> Access on: 28 Oct. 2018.
- Önorm M 7135. Compressed wood or compressed natural bark in state-pellets and briquettes, requirements and test specifications. Vienna, Austria: österreichisches Normungsinstitut; 2000.
- Oshiro, T. L. Production and characterization of briquettes produced with lignocellulosic wastes. Course Completion work da Universidade Tecnológica Federal do Paraná. Londrina, 2016.
- Pereira, U. A., Alexius, N. C. R. The Municipal Solid Waste as a determinant of diseases in the city of Manaus - AM. *Geonorte magazine*, Vol.9, no.31, p.32-53, 2018. (ISSN 2237 - 1419) Special Edition 10 on PPGEORG - UFAM 32 DOI:/geonorte.10.21170.2018.V.9 n.31.32.53
- Pietrosevoli, S., *et al.* Empleo de hojas of Neem (*Azadirachta indica* A. Juss) en control Gastrointestinales nematodes of cattle to grazing. *Journal of la Facultad de Agronomía* 1(Supl.1): 220-225, 1999.
- PRS - Portal of Solid Waste. Environmentally Suitable Final Disposal of Waste, published in November 2013. Available at: <<https://portalresiduossolidos.com/disposicao-final-ambientalmente-adequada-de-rejeitos/>> Accessed on: 02 May 2018.
- Quirino, W. F. *et al.* Calorific power of wood and lignocellulosic wastes. *Biomass & Energy - LPF/IBAMA* v. 1, No. 2, p. 173-182. Brasília, 2004.
- Schütz, F.C.A; Anami, M. H., Travessini, R. Development and testing of briquettes manufactured from lignocellulosic residues of agribusiness. *Innovation and Technology. Universidade Tecnológica Federal do Paraná, Campus Mediatix. Vol. 1, no.1, p. 3-8, 2010.*
- Silva, E. K. S., Figueiredo, L. V., SILVA, E. L. solid wastes: theme of environmental education is inserted in the International Bank of Educational Objects (BIOE). *Journal of Interdisciplinary Research, Cajazeiras*, n 2, Supplement, p.79- 93, Sept. 2017. Available at: <<http://revistas.ufcg.edu.br/cfp/index.php/pesquisainterdisciplinar/article/view/249/pdf>> Access in: 25 Nov. 2018.
- SVMA - Secretariat of Green and Environment of the municipality of São Paulo. Pruning Manual. 2005. Available at: <[http://ww2.prefeitura.sp.gov.br/arquivos/secretarias/meio\\_axis\\_Environment/Biodiversidade/arborizacao\\_urban/0002/M anual\\_pruning\\_final.pdf](http://ww2.prefeitura.sp.gov.br/arquivos/secretarias/meio_axis_Environment/Biodiversidade/arborizacao_urban/0002/M anual_pruning_final.pdf)>. Accessed on: 02 May 2018.
- Uspto. United States Patent and Trademark Office - An Agency of the Department of Commerce. Available at: <<http://patft.uspto.gov>>. Access in: 12 nov. 2018.
- WIPO. PATENTSCOPE World Intellectual Property Organization. Available at: <<https://patentscope.wipo.int/search/en/result.jsf>> .Access on 12 jul. 2018.

\*\*\*\*\*