Using miriti petiole to produce particleboards

Aproveitamento do pecíolo de miriti para produção de painéis aglomerados

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Abstract

This study aimed to use the petiole residues of miriti to partially replace pine wood and evaluate the effects of this incorporation on the physical and mechanical properties of the particleboards. Panels were produced with 0, 25, 50, and 75% of miriti in partial replacement of wood and 12% of urea-formaldehyde adhesive. The chemical-physical properties of miriti residues showed potential particleboard production as they were similar to those of pinewood. For the physical properties, the panels were classified as low density. There was an increase in the compression ratio and, consequently, in the hygroscopicity . For the mechanical properties, it was observed that the modulus of elasticity (MOE) and modulus of rupture (MOR) did not show any statistical differences. For perpendicular traction (PT), there was a significant reduction in 50%. Considering a general analysis of the physical and mechanical properties, up to 40% of mirti can be substituted, as in this situation they meet the properties mentioned in CS-236-66, except for PT for commercialization of the panels.

Keywords: Lignocellulosic material. Particleboards. Physical-mechanical properties. Environmental problems.

Resumo

*O objetivo deste trabalho foi utilizar os resíduos do pecíolo do miriti em substituição parcial da madeira de pinus e avaliar os efeitos dessa incorporação nas propriedades físicas e mecânicas dos painéis aglomerados. Os painéis foram produzidos com 0, 25, 50 e 75% de miriti em substituição parcial de madeira e 12% de adesivo uréia-formaldeído. As propriedades físico-químicas dos resíduos de miriti mostraram potencial de produção de aglomerados, uma vez que foram semelhantes às do pinus. Quanto às propriedades físicas, os painéis foram classificados como de baixa densidade. Houve aumento na taxa de compressão e, conseq*uentemente, na higroscopicidade. *Para as propriedades mecânicas, observou-se que o módulo de elasticidade (MOE) e o módulo de ruptura (MOR) não houve diferença estatística. Para tração perpendicular (TP) houve redução significativa de 50%. Considerando uma análise geral das propriedades físicas e mecânicas, é possível uma substituição em até 40% de miriti, pois nessa situação atendem as propriedades mencionadas na CS-236-66, com exceção da TP para a comercialização dos painéis.*

Palavras-chave: *Material lignocelulósico. Painéis aglomerados. Propriedades físico-mecânicas. Prolemas ambientais.*

Introduction

Brazil is a world leader in timber wood panel manufacturing (INDÚSTRIA…, 2021). In the first quarter of 2021 compared to the same period in 2020, the Brazilian market had a 26.2% increase in its domestic consumption, and a 14.3% increase in exports (BESSA, 2021; INSTITUTO…, 2021). This, added to other factors resulting from COVID-19, resulted in a crisis in the supply of raw materials for production and shortages including wood panels, until the present day (COSTA, 2022).

The search for other sources of lignocellulosic materials or the use of agro-industrial residues for manufacturing low-density conventional particleboard is necessary. This is due to the fact that these panels are manufactured with particles of lignocellulosic material, usually wood, bonded with synthetic adhesives, and hot pressed (IWAKIRI; TRIANOSKI, 2020).

Taking this into account, biomass residue particleboards associated with wood offer promising prospects for developing more competitive panels (SANTOS *et al*., 2021). It was found that various residues, such as coffee husks, macadamia carpels, papaya stalks (MARTINS *et al*., 2021), jupati (VELOSO *et al*., 2020a), sorghum bagasse (GUIMARÃES JÚNIOR *et al*., 2016) among others, can be viable alternatives for partial or total replacement of wood in panels.

Among these various renewable raw materials available in the world, one option would be to use residues from miriti (*Mauritia flexuosa L.*), a species of palm from the Amazonian region, also known as buriti, which has great socio-economic potential. This palm is mainly found in the northern region of Brazil, but it is also often found in the states of Maranhão, Piauí, Bahia, Ceará, Distrito Federal, Minas Gerais, and Mato Grosso. In other South American countries, this species is also found as moriche (Colombia and Venezuela), canangucho (Colombia), morete (Ecuador), aguaje (Peru), bororo (Bolivia) and bachê (Guyana French) (FERREIRA *et al*., 2021).

The miriti palm has leaves arranged in a fan, making it possible to remove fibers, which can be used to make mats, rope, hats, among other products. The wood can also be used to make handicrafts. Furthermore, the fruit is reddish-brown and the oil from the pulp can be used for frying, and after fermenting, it turns into wine (INSTITUTO…, 2021). The internal part of the petiole (stalk that connects the leaf blade to the branch) has no defined use and it is considered as a residue of the process.

Owing to the lack of wood and sustainable development, the production of particleboards with miriti residue can be a viable alternative for these residues, mainly to the panel industry. Thus, the aim of this study was to use miriti petiole residues to partially replace pinewood and to evaluate the effects of this incorporation on the physical and mechanical properties of particleboard.

Material and methods

Materials

Miriti petioles were collected in the Guajará de Beja community, located in the municipality of Abaetetuba, Pará. To obtain the petioles, the leaves had to be removed, leaving the petioles and the main rachi to the side. They were peeled to obtain the inner part, which is the raw material used in this work (Figure 1a). The material was taken to the Wood Panel Experimental Unit (UEPAM) of the Federal University of Lavras (UFLA) where it was crushed in a hammer mill to reduce and standardize its size (Figure 1b).

The 17-year-old *Pinus oocarpa* wood was collected at the University campus, located in the municipality of Lavras in southern Minas Gerais, under the coordinates

21º 14' 45" S 44º 59' 59” W and an altitude of 920 m. The "sliver" particles were generated in a hammer mill. Three trees were felled using a chainsaw, in which five disks were removed from each tree at heights corresponding to 0, 25, 50, 75 and 100% of commercial height, for chemical characterization and basic density. The trees were then sectioned into short logs measuring 58 cm. The material was taken to the Experimental Unit of Wood Panel Production (UEPAM) at UFLA and sectioned into four parts using a band saw, obtaining two opposing wedges for chemical analysis and another two used for making the specimens with dimensions 2.5 x 2.5 x 1.5 cm for the basic density. The “sliver” particles were generated in a hammer mill.

The pine and miriti particles were classified in a vibrating system of 12 mesh (1.68 mm) and 20 mesh (0.84 mm) superimposed sieves to discard coarse particles and a uniform particle size. Finally, the particles were oven-dried with forced air circulation until 3% moisture at a dry base.

The resinous material was acquired in the Lavras trade and according to the following specifications. The urea-formaldehyde (UF) adhesive presented the following characteristics: solids content of 70.04%, pH of 6.86, a viscosity of 1810 cP, and gelatinization time of 53 s.

Characterization of lignocellulosic materials

The basic density of pine wood was determined according to the NBR 11941 standard (ABNT, 2003). Similarly, the miriti particles were also determined, adaptated in the volume measurement, (displacement method), according to Silva *et al*. (2015). The moisture in the dry basis of the particles was obtained from the precepts of the NBR 14929 standard (ABNT, 2017a). To determine the chemical characterization, the particles passed through a 40 (0.420 mm) sieve and were retained in a 60 (0.250 mm) sieve. The chemical analysis was determined using triplicates. Total extractives were quantified according to NBR 14853 (ABNT, 2010), insoluble lignin content by NBR 7989 (ABNT, 2010), ash by NBR 13999 (ABNT, 2017b), and holocellulose obtained by the difference method H(%) = (100 - % Total extractives - % Insoluble lignin - % Ash).

Production of particleboard panels

The panels were produced with a nominal density of 600 kg.m-^{3}, 300 x 300 x 15 mm dimensions, with the replacement of pine particles, in mass percentage, by miriti particles, as shown in Table 1. The 100% replacement was not performed, as in other studies found in the literature, because the density of residue was very low (MARTINS *et al*., 2018). The UF adhesive is in a proportion of 12% in relation to the dry mass of particles.

The pine and miriti particles were glued and the mattress pre-pressed in a manual press at room temperature with a pressure of 0.5 MPa, to remove air and pre-consolidate the panel. Afterwards, the panel went through the pressing cycle at a temperature of 160 ºC and a specific pressure of 4 MPa for a period of 15 min, obtaining homogeneous panels (Figure 2). Three panels were made for each treatment.

After pressing, the panels were acclimatized at a temperature of 20 ± 3 °C and relative humidity of 65 ± 5% until they reached a constant mass. Afterwards, they were submitted to the squaring process to remove the edge effects, and later the circular saw to remove the specimens according to Figure 3.

Figure 1 **– (a) Miriti petiole structure and (b) miriti particles to produce panels**

Table 1 **– Composition of particleboards**

Treatments	Pine (%)	Miriti (%)
T1	100	0
T2	75	25
T3	50	50
T4	25	75

Figure 2 - **Production of particleboard panels**

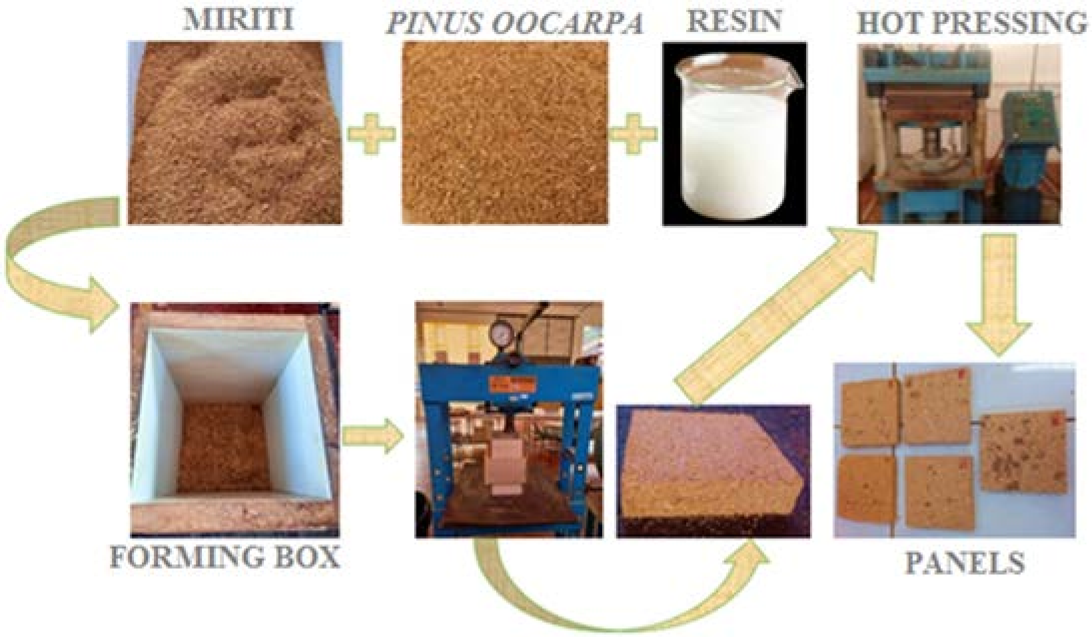
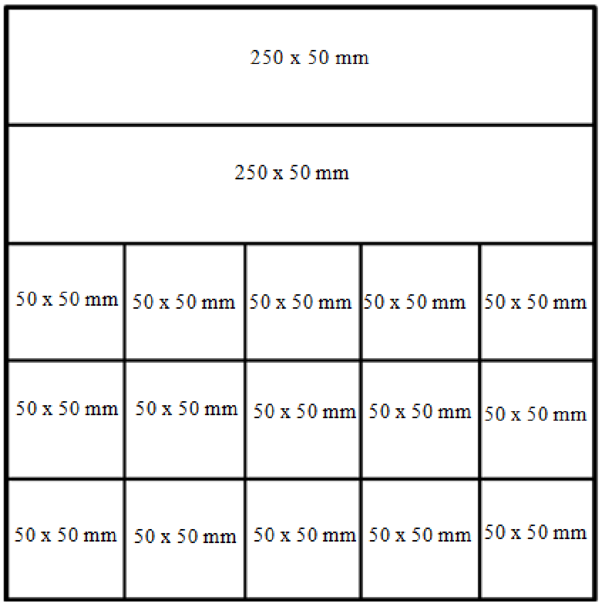


Figure 3 - **Sampling performed in the particleboards to obtain specimens and to determine the physical and mechanical properties**



Source: Furtini *et al.* (2022).

Characterization of particleboard panels

To evaluate the physical and mechanical properties, the tests were performed in triplicate according to the standards established in Table 2. The compaction ratio of each panel was calculated through the basic density ratio of the raw material used (it varied according to the treatment due to the different percentages of a straw) by the apparent density of the panel.

Table 2 **– Physical and mechanical properties**

Tests	Methodology	Dimensions of specimens (mm)
WA 2h / WA 24h	D-1037 (AMERICAN..., 2012)	50x50
TS 2h /TS 24h	D-1037 (AMERICAN..., 2012)	50x50
NRT	D-1037 (AMERICAN..., 2012)	50x50
Moisture content	NBR 14810-2 (ABNT..., 2018)	50x50
Apparent density	NBR 14810-2 (ABNT..., 2018)	50x50
Perpendicular traction	NBR 14810-2 (ABNT, 2018)	50x50
MOE / MOR	A208.1-09 (AMERICAN..., 1993)	250x50

Note: WA2h: Water absorption, 2h;
WA24h: Water absorption, 24h;
TS2h: Thickness swelling, 2h;
TS24h: Thickness swelling, 24h;
NRT: Non-Recoverable Tax;
MOE: Modulus of elasticity; and
MOR: Modulus of rupture.

Statistical analysis of experimental data

A completely randomized design (CRD) was adopted to produce the particleboards with 4 treatments. For the chemical composition and mechanical properties of the panels, the Scott-Knott mean test was used at a 95% confidence level and standard deviation. To characterize the physical properties of the panels, analysis of variance and regression were used, both at 5% significance, except for apparent density and moisture, evaluated using the F test in the analysis of variance (ANOVA).

Results and discussion

Physical and chemical characterizations of pine and miriti

The mean values obtained for the basic density of pinewood and miriti residue were 440 ± 0.09 and 60 ± 0.04 kg.m-^{3}, respectively. According to the literature, the pine density was close to that obtained by Mendes *et al*. (2018) 480 kg.m-^{3}. Furthermore, the miriti residue showed close to the 90 kg.m-^{3} sugarcane bagasse obtained by Mendes *et al.* (2015). According to Scatolino *et al.* (2017), a low density is one of the fundamental requirements for using lignocellulosic materials to produce the particleboard. As this property is a requirement for the compaction ratio, which is the ratio between the density of the panel and the density of the wood, to be at least 1.3, so that the densification necessary for the formation of the panel occurs (IWAKIRI; TRIANOSKI, 2020).

For dry base moisture, an average of 5.06% was found for pinewood and 9.18% for miriti residue. The moisture content directly influences the resin curing, the pressing time, and the pressure needed to consolidate the panel to the desired final thickness (BARROS FILHO, 2009). For this reason, the particles were dried in an air circulation oven until humidity on a dry basis of 3%, as recommended in the literature, to manufacture particleboards.

The average values for the chemical characterization of pine particles and miriti residue are shown in Table 3. It can be observed that for the content of total extractives, insoluble lignin, and ash, there was no statistical difference, which is favorable because the miriti residues showed a similar composition to pine wood.

According to the literature, the total extractive values were close to those of Matos *et al*. (2019) and lower than that of Mendes *et al*. (2017), who studied *Pinus oocarpa* wood and obtained mean values of 6.33% and 10.8%, respectively. For agricultural residues, Soares *et al*. (2017) and Guimaraes Júnior *et al*. (2016) found values higher than 19.59% for sugarcane bagasse and 14.55% for sorghum, respectively. The values obtained in this study were satisfactory as high extractive contents can block the contact of the wood, adhesive, and the passage of water. They can also delay the adhesive evaporation rate, increasing the pressing time (IWAKIRI; TRIANOSKI, 2020).

Table 3 **– Chemical composition of lignocellulosic materials**

Chemical components	Pine	Miriti
Total Extractives (%)	5.43 ± 1.04 A	4.45 ± 1.03 A
Insoluble lignin (%)	28.98 ± 1.21 A	23.81 ± 0.42 A
Ashes (%)	1.28 ± 0.07 A	2.42 ± 0.57 A
Holocellulose (%)	66.43 ± 2.67[a]	69.91 ± 0.30 B

Note: *averages followed by the same letter, in the column, do not differ from each other by the Scott-Knott test, at a significance level of 5%.

For insoluble lignin, the values obtained in this study are in agreement with the literature. Furtini *et al.* (2021), for example, obtained an average content of 29.20% for pine wood. Regarding agricultural residues, the values in the literature were lower. Selamat *et al.* (2019) reported 20.15% for rice husk and 19.15% for palm trunk. The highest percentage of lignin in miriti is considered satisfactory, as it contributes to adhesion mechanisms and favors the particle bonding process (BUFALINO *et al*., 2012).

Regarding the ash content, Andrade *et al*. (2019a) studied the pinewood and found an average content of 0.20% lower than the respective study. For agricultural residues, Protásio *et al.* (2012) showed higher levels for coffee residues (4.92%) and rice husks (16.78%). High concentrations of ash are harmful to the mechanical performance of the panel, as they can block adhesion and affect the quality of particle bonding (SOARES *et al*., 2017).

For holocellulose, the values found show to be satisfactory in the literature. Mendes *et al.* 2014 presented a value similar to 66.50% for pinewood and lower than miriti residue. Concerning agricultural residues, Faria *et al*. (2018) reported a higher content of 75.52% for corn cob. According to Fiorelli *et al.* (2018), holocellulose (cellulose + hemicellulose) is constituted by amorphous regions and has a high-water absorption capacity, thus it can interfere with the physical properties of the panels, and therefore lower contents are desirable.

In general, the presented contents of the miriti residue do not present limitations, revealing a possible alternative material for manufacturing particleboards in terms of the chemical composition.

Physical properties of particleboard panels

The mean values found for the apparent density of the panels are shown in Figure 4. There was no statistically significant effect of the addition of miriti on the apparent density of the particulate panels.

It can be observed that the densities varied between 480 and 530 kg.m-³. According to Iwakiri and Trianoski (2020), the panels were classified as low density, as they are up to 590 kg.m-³. It was also observed that the bulk density was lower than the stipulated nominal density of 600 kg.m-³. This fact can be justified by the loss of particles during the formation of the mattress, which can also be related to the return in thickness of the panels, after removing the hot press and packaging, with a consequent increase in the volume of the panels and reduction in the initial nominal density (GUIMARES JÚNIOR *et al*., 2016).

The values referring to the compaction ratio of the panels are shown in Figure 5. The increase in the compaction rate with the increase in the miriti rate was due to the low bulk density of the material as a greater number of particles were added to produce the plate with the desired bulk density

According to Maloney (1993) and Moslemi (1974), the compaction ratio must be in the range of 1.3 to 1.6 for an adequate densification and consolidation of the panel to occur in the desired final thickness. According to this consideration, taking into account the maximum value of 1.6, a replacement of up to 22% of the waste is desirable. However, for the other treatments, it is not an indication of its unfeasibility (MARTINS *et al*., 2018).

The average values obtained for moisture are shown in Figure 6. It can be observed that there was no significant effect of the addition of miriti to the panels.

According to the literature, Andrade *et al*. (2019b) studied the addition of pulp residue in particleboard production, with the design of 0, 25, 50, 75, and 100%, and obtained an average variation of 7.37 to 8.21%, which are higher values than the present study. Moreover, Brito *et al*. (2020) obtained an average of 7.70% of particleboards based on sugarcane bagasse and bamboo culm particles. The Brazilian standard NBR 14810 (ABNT, 2006) stipulates moisture values between 5 and 11%, therefore all treatments are within the aforementioned standard, thus indicating a good behavior of miriti, as they presented similar contents to pine wood.

Figure 4 – **Apparent density of the particleboards**

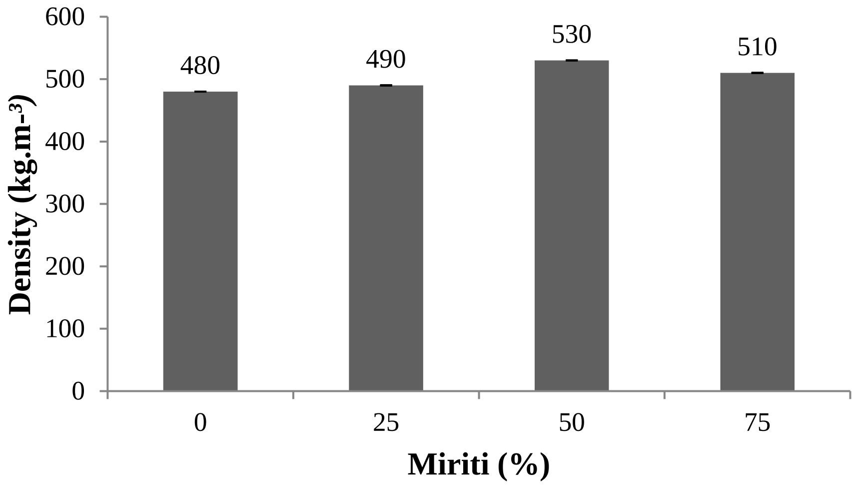


Figure 5 – **Compaction ratio of particleboards as a result of the replacement of pine by miriti**

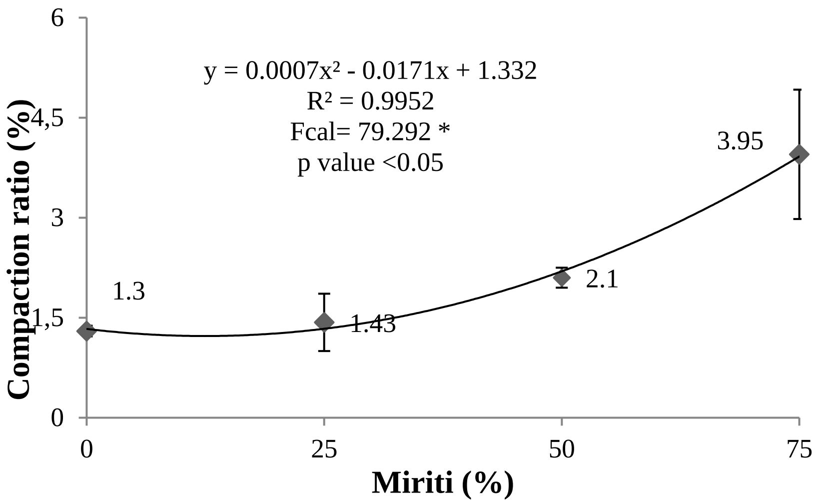
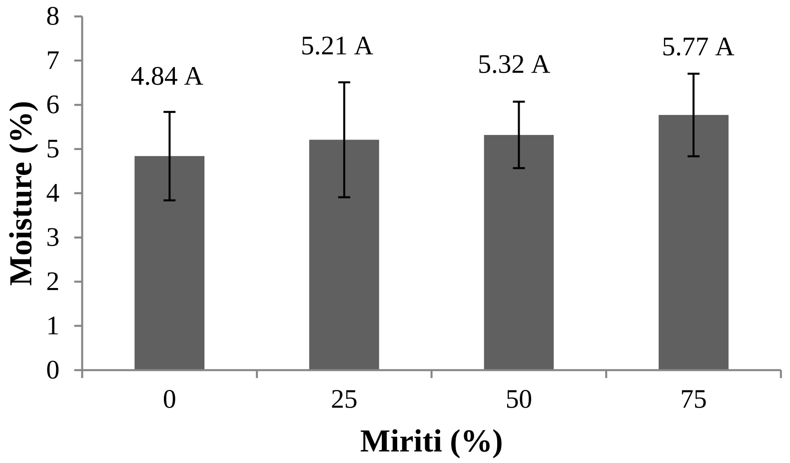


Figure 6 – **Moisture content in the dry base of the particleboards as a result of replacing pine by miriti**



The mean values of water absorption after 2h and 24h of immersion (WA2h) and (WA24h) respectively, are shown in Figure 7. A significant and positive linear relationship can be observed. For every 1% of miriti inserted, there was an increase of 0.91% for WA2h and 1.24% for WA 24h.

This rise can be explained by the increase in the compaction ratio of the panels. The panels produced with greater amounts of miriti showed an increase in this property, thus providing a greater number of particles compacted in the same volume. Consequently, there was greater exposure of hydroxylic sites, which can lead to a greater affinity of this material with water (GUIMARÃES JÚNIOR *et al.*, 2016). Another factor would be the high content of holocellulose found for miriti residues compared to pine wood as this property presents free hydroxyl groups which can adhere to water, and consequently the panels can present higher levels of water absorption.

The same trend was found in the literature by Martins *et al*. (2018) when replacing the wood with soybean pod residue in different percentages (0, 25, 50, 75, and 100%). There was an increase in water absorption after 2 and 24 hours of immersion in water, with average levels of 129% and 137%, respectively, which are levels close to the present study. Furthermore, Mesquita *et al*. (2016) found that by replacing wood with sisal fibers (0, 10, and 20%), there was an increase of 30% and 25% in water absorption after 2 and 24 hours of immersion in water as the proportion of sisal fibers was added.

The mean values obtained for the thickness swelling property, after 2- and 24-hours of immersion in water (TS 2h) and (TS 24h), respectively, are shown in Figure 8. A significant and positive linear relationship can be observed. For every 1% of miriti added, there was an increase of 0.32% for IE 2h 0.30% for IE 24h.

The increase in the thickness of the panels is a consequence of water absorption and refers to the dimensional stability of the panel (VELOSO *et al.*, 2020b). According to Silva *et al*. (2015), this result can be explained by the gradual increase in the compaction ratio, leading to a decrease in the amount of resin per unit area. Another factor that could influence the dimensional stability of the panels would be the extractives that have the ability to interfere with the adhesive curing, but in this case, there was no influence as the results for pinewood and miriti were statistically similar.

Concerning the literature, when studying particleboard panels with 0, 25, 50, 75, and 100% of soy husk in relation to wood particles, Guimarães *et al.* (2019) reported the same trend as the present study. The values found for IE 2h and IE24h ranged from 10.00 to 75.95% and from 17.49 to 80.49%, for 2 and 24 immersion, higher values, showing the good behavior of the miriti. When replacing wood with soybean pod residues, Martins *et al*. (2018) found there was an increase in swelling in thickness of 2 and 24 h. According to the American Commercial Standard (CS-236-66, 1968), for IE 24h, the maximum values must be 35%, and therefore treatments up to 40% of miriti met the standard.

For the thickness non-return rate (NRT), the mean values obtained are shown in Figure 9. A significant and positive linear relationship can be observed. For every 1% of miriti entered, there was an increase in the order of 0.28%.

Figure 7 **– Water absorption after 2 and 24 hours by the panels due to the replacement of pine by miriti**

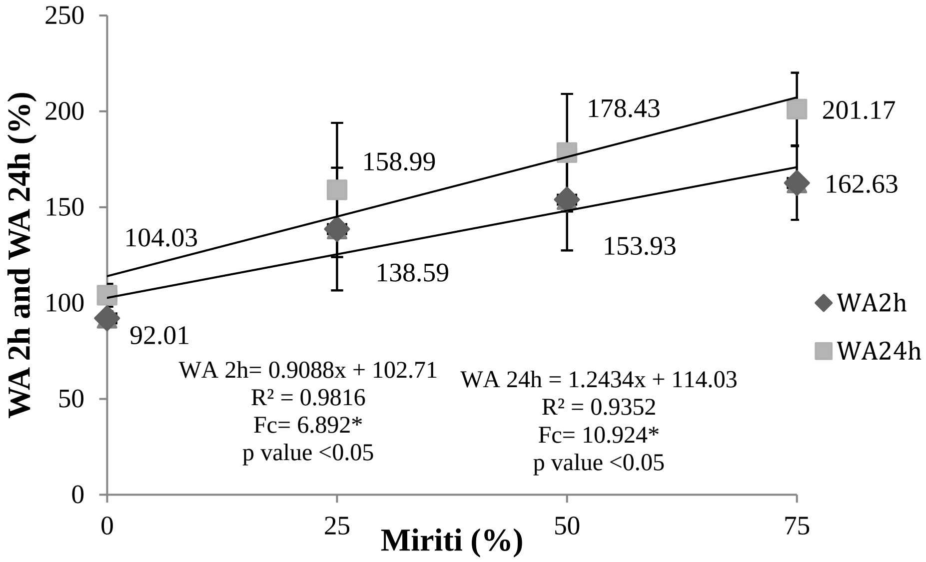


Figure 8 **- Thickness swelling after 2 and 24 hours of immersion of the particleboards due to the replacement of pine by miriti**

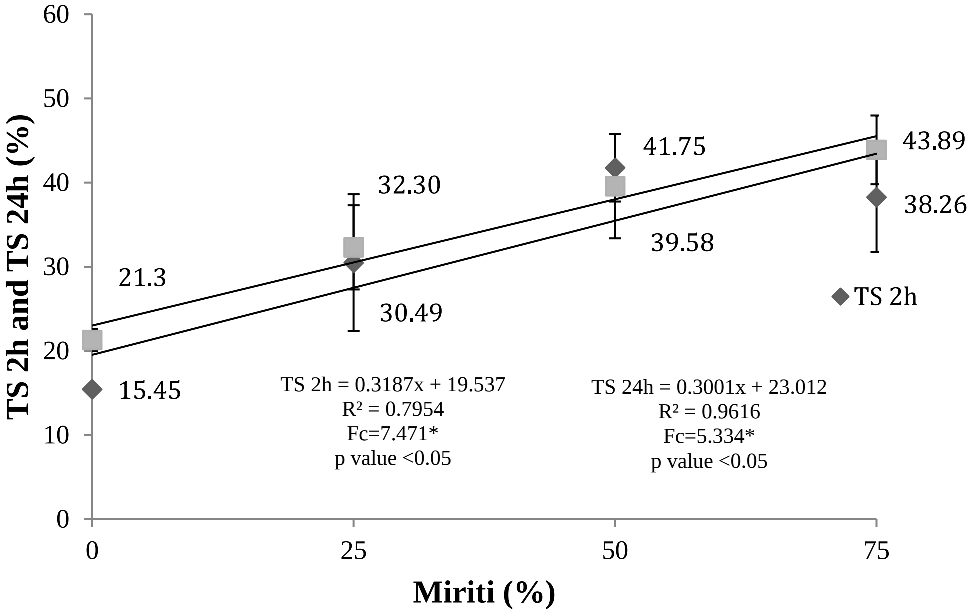
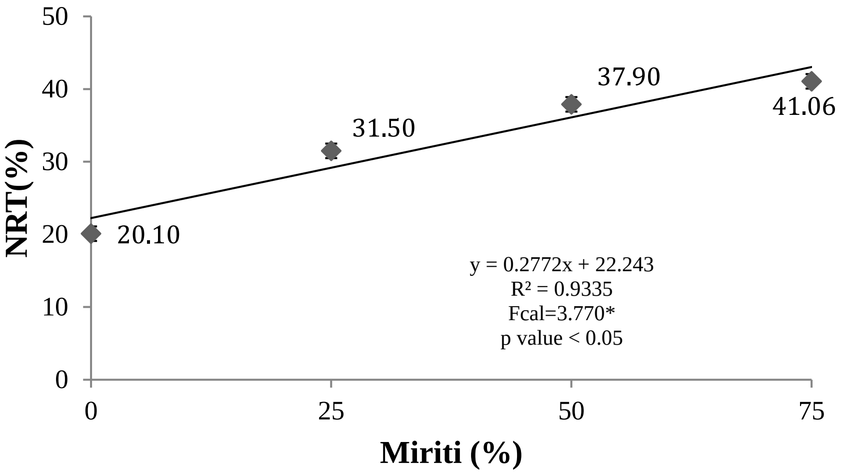


Figure 9 **- Rate of non-return of the thickness of the particleboards due to the replacement of pine by miriti**



It can be observed that NRT followed the same trend as the properties of WA and TS. According to Mendes *et al*. (2014), the IE24h property is directly related to NRT due to the greater variation in thickness resulting from the release of compressive stresses imposed by the panel during pressing, which makes it partially unrecoverable. Given the literature, the values obtained in this study are higher. Brito *et al.* (2020) obtained an average of 14.90% for the particleboards based on sugarcane bagasse and bamboo culm particles, while Mendes *et al*. (2014) studied homogeneous particleboards produced with *Pinus oocarpa* and obtained an average of 25.1%.

Mechanical properties of particleboard panels

The mean values for the modulus of elasticity (MOE), modulus of rupture (MOR), and perpendicular traction (TP) are described in Table 4.

It can be seen that there was no statistically significant effect of the addition of miriti on the properties of MOE and MOR in the particleboard, that is, this residue had the same performance as pine wood. As observed in the chemical analysis of miriti and pine (Table 3), the material properties were quite similar, which may have influenced the MOE and MOR to have followed the same behavior.

Table 4 **– Mechanical properties of particleboard panels**

Treatments	MOE (MPa)	MOR (MPa)	PT (MPa)
T1	1087.20 ± 759.86 A	6.86 ± 1.16 A	0.23 ± 0.09 A
T2	1273.27 ± 107.82 A	6.54 ± 4.99 A	0.13 ± 0.05 B
T3	1204.50 ± 100.30 A	6.45 ± 0.86 A	0.10 ± 0.04 B
T4	1049.44 ± 124.87 A	7.36 ± 0.75 A	0.11 ± 0.03 B

Note: *averages followed by the same letter, in the column, do not differ from each other by the Scott-Knott test, at a significance level of 5%. Values indicate the mean and standard deviation. Where: MOE: Modulus of elasticity; MOR: Modulus of rupture; and PT: perpendicular traction.

According to the literature, studies reported a tendency for a decrease in mechanical properties, as they replaced pine or eucalyptus wood with residues. Martins *et al*. (2018) worked with the replacement of wood particles by soy residues in particleboard panels in the proportions of 0%, 25%, 50%, 75%, and 100% observed a decrease in the MOE and MOR, ranging from 1297.68 to 434.21 MPa and 7.57 to 2.41 MPa respectively. Therefore, the authors found a possible replacement in up to 25%, which were lower values than in the present study.

As well as Veloso *et al*. (2020a) replacing wood with jupati in particleboard panels at proportions of 0%, 10%, 20%, and 30% observed a variation of 1469.11 to 1084.57 MPa for MOR and 6.55 to 4.75 MPa for MOE. The authors also reported that the replacement of 15% of jupati is possible, while in the present study, a replacement of up to 75% is possible. According to the CS 236-66 commercial standard (COMMERCIAL…, 1968), the low-density particleboards, produced with the urea-formaldehyde adhesive, must present the minimum average value for the MOE of 1029.7 MPa and MOR of 5.5 MPa, therefore all treatments met the standard.

For perpendicular traction, there was a significant reduction with the replacement of wood by miriti. According to Guimarães Junior *et al*. (2016) and Scatolino *et al*. (2017), the low density of the residue provides an increase in the compaction ratio, resulting in lower availability of adhesive per particle, and consequently a lower internal bond, given the low particle sticking. Considering that the miriti residue has a low density, a reduction in values for TP was expected.

Some studies have also reported a decreasing trend in perpendicular traction properties, with an increase of residues. Guimarães *et al*. (2019) studied particleboard panels with a replacement of soybean husk in relation to wood particles and found mean values between 0.86 and 0.04 MPa, with decreased values decreasing to the increase in the percentage of soybean husk, showing the same trend of the present study.

Sahin (2020) studied the potential use of forest residues (0%, 10%, 20%, 30%, 40% and 50%) as raw material in the particleboard manufacture, the authors reported a decrease between 0.29 and 0.13 MPa with the replacement of wood by residues, showing to be close to the present study. According to the CS 236-66 (COMMERCIAL…, 1968) commercialization standard, the low-density particleboards must present the minimum average value for TP of 0.14 MPa, therefore the panels with the addition of miriti did not reach the minimum value. A208.1-99 (AMERICAN…, 1999) stipulates a minimum average value of 0.10 MPa for this property, and therefore all panels reached the recommended value.

An alternative that could improve the TP values would be to increase the specific mass of the panels. Melo and Del Menezzi (2010) studied the influence of the specific mass on the physical-mechanical properties of agglomerated Eucalyptus grandis panels with different specific masses (0.60, 0.70 and 0.80 g/cm³) and observed values of 0.28, 0.31 and 0.35 MPa, respectively. Thus, the authors concluded that as the specific mass of the panels increases, the TP also increases.

Another alternative would be larger particles of miriti because, according to Maloney (1993) and Moslemi (1974), particles with smaller dimensions, require greater consumption of adhesives, as the smaller the particle, the greater its superficial area. Using the same amount of adhesive, the panel produced with larger particles will show greater PT, as there is a smaller surface area and, consequently, greater availability of adhesive per unit area.

Conclusion

The main objective of this study was to evaluate the effect of adding miriti residue particles on the properties of low density panels.

The results showed that the chemical and physical properties of miriti residues have the potential for the production of low-density agglomerated boards as these constituents had similar levels to pinewood, the one normally used for producing these boards.

For the physical properties of the panels, the partial replacement of wood by miriti provided an increase in the compaction ratio, influencing the increase of 0.91% for WA2h and 1.24% for WA 24h for each 1% of miriti added. There was also an increase for TS 2h (15.45 – 41.75%), TS24h (21.3 – 43.89%), and for NRT where the average values varied from (20.10 – 41.06%).

For mechanical properties such as MOE (1049 – 1273 MPa) and MOR (6.55 – 7.36 MPa), there was no statistical difference, revealing a good potential of miriti for panel production. Regarding the PT (0.23-0.10 MPa), there was a significant reduction in the replacement of wood by miriti, considering that the miriti residue has a low density, therefore a reduction in these values was expected.

Considering a general analysis of the physical and mechanical properties, it is possible to substitute pine for miriti in up to 40% for the commercialization of the panels according to the CS-236-66 standard (except for PT). Thus, the use miriti petioles to produce low density agglomerated wood panels is promising to replace pine wood.

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