gum Arabic content of the mix which may be due to the availability of enough binder to coat the surfaces of the mahogany leaves particles, there-by displacing the air in the void spaces, and as such increasing the bond between individual particles, which in turn resulted in increase in the flexural modulus of the overall board. The results presented are also in agreement with those reported by [13]. The minimum acceptable value of modulus of elasticity as specified by the American National Standard Institute standard [12] is 550N/mm^2. The results obtained show that all the boards produced met this minimum requirement of the American National Standard Institute for general-use particleboards.

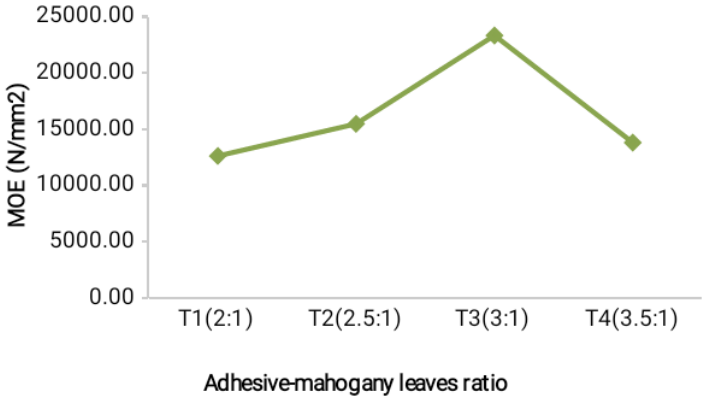

Fig. 9: Average Modulus of Elasticity of Adhesive-Mahogany Leaf Particleboard using different adhesive-mahogany leaf ratio

3.3.2 Effects of Density on the Modulus of Rupture of Mahogany Leaves Particleboard

Practically all the physical and mechanical properties of particleboards are related to density. Figure 10 shows the relationship between particleboard density and its modulus of rupture. From this graph, it can be observed that for each mix ratio, modulus of rupture increases with increase in density of the board. This is as expected because the more the particles are compacted, the greater the contact between them, thereby achieving good chip-to-chip contact and consequently increasing the density and strength of the board. However, in engineering, lightweight but high strength materials produced at a relatively cheap cost are preferred. Since particleboards from the first treatment T1 satisfies the requirements of the code and reduces the number of materials used, it can be adopted for use.

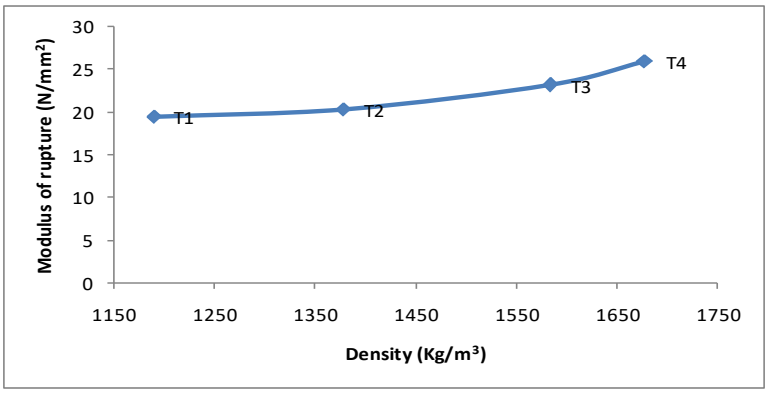

Fig. 10: Modulus of Rupture against Density

3.3.3 Effect of Density on the Modulus of Elasticity of the Particleboards

Figure 11 shows the relationship between modulus of elasticity and density of the mahogany leaves' particleboards. Modulus of elasticity increases with increase in density from 12537.05N/mm^2 at 1188.89Kg/m^3 to 23149.12N/mm^2 at 1583.33Kg/m^3 for the first three mixes but decreases afterward to 13619.40N/mm^2 at 1677.78Kg/m^3. The sudden decrease may be as a result of too much quantity of binder that has made the particleboard too brittle.

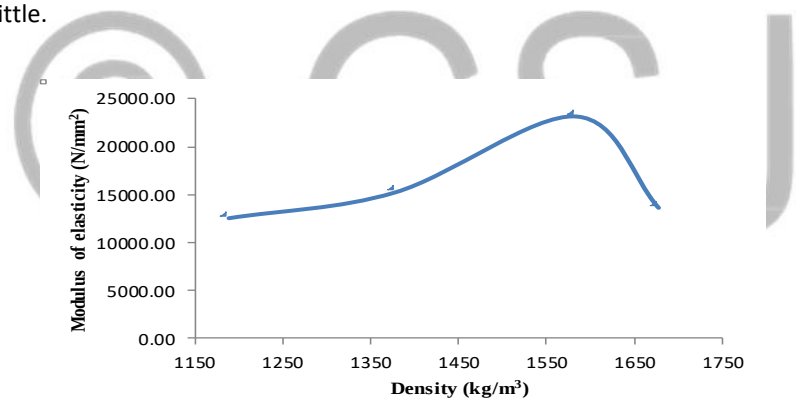

Fig. 11: Modulus of Elasticity against Density

3.4 Cost Analysis of Producing Mahogany Leaves Particleboard

Table 5 shows the cost analysis to produce mahogany leaves particleboard. ₦3,300 was used to produce each square meter of the mahogany leaves particleboard which is less compared to the ₦5,500 per square meter of the conventional urea-formaldehyde particleboard (Brazilian Brand) and ₦5,000 (Indian Brand), sold at the market. This shows that mahogany leaves particleboard is more economical.

Table 5: Cost of Materials and Utilities

	Cost of Materials and Utilities	
Materials	Quantity	Cost (N)
Gum Arabic	0.0045 ton	750
Mahogany leaves		0
Drying and Milling		300
Polyethene		20
Water	5 Liters	20
Labour		1800
Total		2,890

L(m)	B(m)	D(m)
0.2	0.05	0.006

Area (m^2) of 1 sample	0.01
Number of Board Samples	88
Total area	0.88
Cost per square meter	₦3,284.091

$$\text{Cost ratio} = \frac{3284.091}{5500} = 0.59$$

4.0 CONCLUSIONS

In this paper, the mechanical properties of particleboards produced from mahogany leaves particles and gum Arabic as binder were investigated and the following conclusions can be drawn:

1. Dominant elemental composition present in Mahogany Leaves particles and gum Arabic are; Cu(0.14mg/kg : 116.55mg/kg), Ca(321.17mg/kg : 901.84mg/kg), mg(15.54mg/kg : 1333.60mg/kg), Zn(1.58mg/kg : 26.51mg/kg), Fe(0.98mg/kg : 192.12mg/kg) and Mn(0.07mg/kg : 20.22mg/kg) respectively.

2. Particleboards produced by the weight of gum-Arabic to mahogany leaves particles of 3:1 satisfy the ANSI/A208.1-1999 standard on the mechanical properties of general-purpose boards.

3. Particleboards produced using gum-Arabic to mahogany leaves ratio of 3.5:1 have higher flexural strength while that of ratio 3:1 have higher MOE with average values of 25.94N/mm^2 and 23,149.12N/mm^2, respectively. The particleboards produced can be classified as high-density boards (H) for having all density values above 800kg/m^3.

4. An environmentally friendly particleboard that satisfies ANSI/A208.1-1999 standards can be produced using mahogany leaves particles and gum Arabic as binder.

5. Cost-effective particleboard can be produced from mahogany leaves due to the low-cost ratio of 0.6 obtained.

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