Chapter 115

Comparative Study Of Poly (Butylene Adipate Co-Terephthalate) Nanocomposites With Zinc And Molybdenum Oxides

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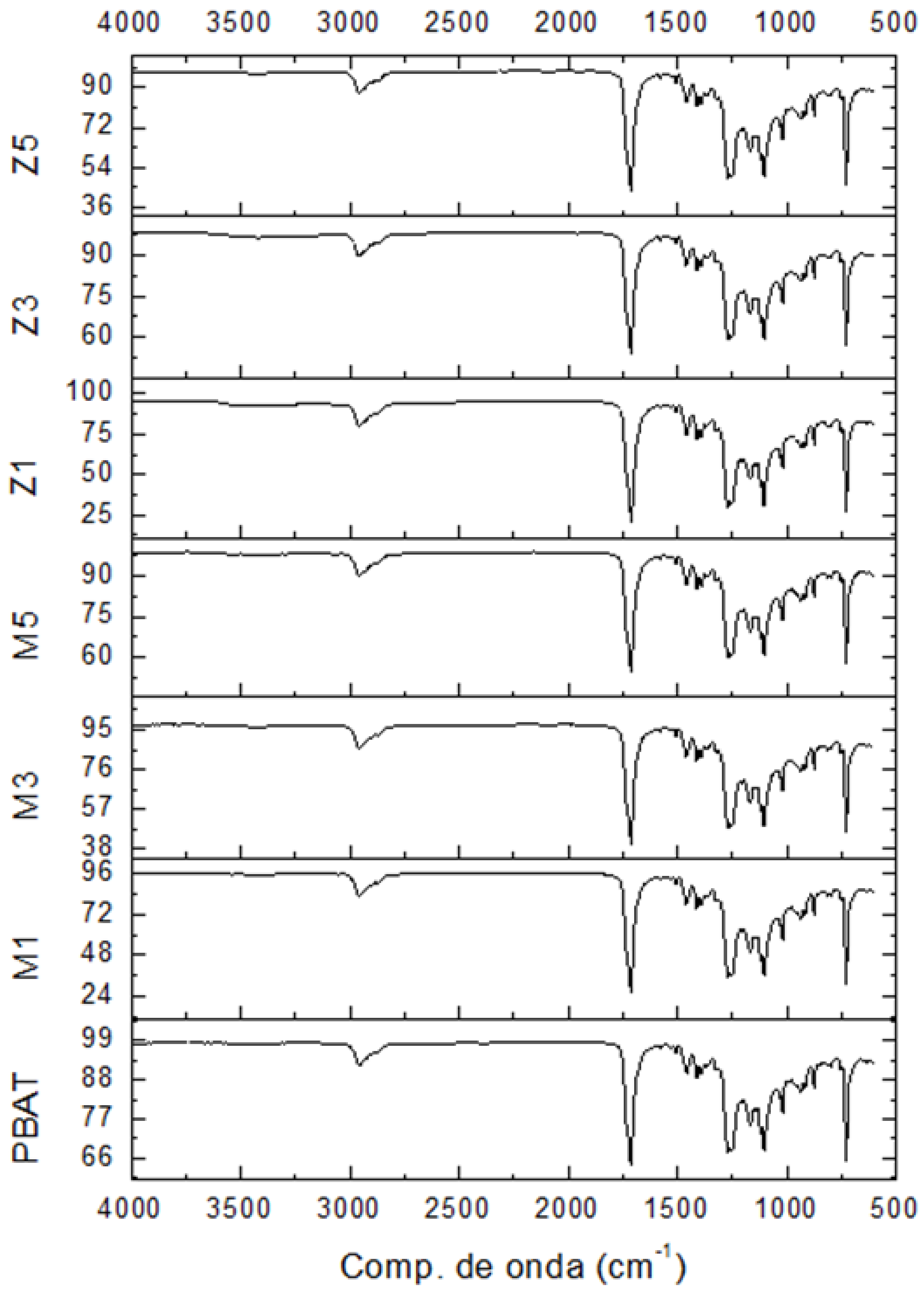
ABSTRACT
Given the large and growing demand for plastics, studies on nanocomposites of biodegradable polymers such as polybutylene adipate co-terephthalate (PBAT) are justified. This polymer is certified for composting; it is printable, suitable for food contact, water resistant, and performs similarly to polyethylene[1, 2] . Metal oxide nanoparticles (NPs) such as MoO3 and ZnO are potential fillers to, in addition to improving mechanical properties, confer antimicrobial, anti-UV activity and modulate the biodegradability of polymer matrices such as that of PBAT[3, 4, 5] .
The effects of different concentrations of ZnONPs were observed and compared to MoO3 NPs, whose relevant properties still lack further study. In this work, seven films prepared by casting with CHCl solvent evaporation were studied3 . The tags PBAT, Z1, Z3, Z5, M1, M3 and M5 correspond to the pure polymer samples and their combinations with 0.1; 0.3 and 0.5 % of zinc and molybdenum oxide NPs, by mass, respectively.
The Fourier transform infrared spectroscopy (FTIR) ratified the total removal of the solvent and the maintenance of the bands of the main functional groups of the polymeric matrix, even after the incorporation of the NPS. In the thermogravimetric analysis (TGA), only one degradation event was observed for all samples; in M1 and especially in M3 the thermal resistance increased, while, with the addition of zinc oxide, especially in Z5 and Z3, this property was reduced. There was no expressive change in the degradation onset temperature (Tonset) of M5 in relation to PBAT, suggesting that this concentration of MoO_3 cannot promote increment in the thermal property of this matrix. The X-ray diffraction (XRD) results of M1 and M3 suggested a better dispersion than M5, the only composite in which there was no increase in the degree of crystallinity in relation to pure PBAT, indicating possible agglomeration. In time domain nuclear magnetic resonance (TD-NMR) analysis, the curves of M3 present a narrower base, indicating greater homogeneity and especially good dispersion in this system, corroborating the other analyses. The reduced return time of the magnetization to the longitudinal axis (T1 H) of M5 and the increased molecular mobility of this system were associated with the crystalline rearrangement. When measuring the water activity (aw) thinking in the application of these films as active packaging, Z3 and M1 stood out, with lower propensity to microbiological attack, and a linear trend (R^2 > 0.9) was observed for this property with the incorporation of molybdenum nanotrioxide in poly(butylene adipate co-terephthalate). The worst aw data were observed in Z1, with M3 and M5 being similar to Z5. Still, all observed aw values were below the recommended value for food packaging, 0.7 (the value at which susceptibility becomes most relevant).
Thus, it was shown to be possible to incorporate zinc and molybdenum metal oxides in the PBAT matrix, via casting, with good distribution and better dispersion of fillers in the range of 0.3% by mass. Moreover, it was observed that different types and proportions of particles resulted in different effects on the microstructure of the matrix (thermal resistance, crystallinity, molecular mobility and water activity), without causing interaction capable of affecting the molecular composition of the material, at levels detectable by FTIR-ATR.

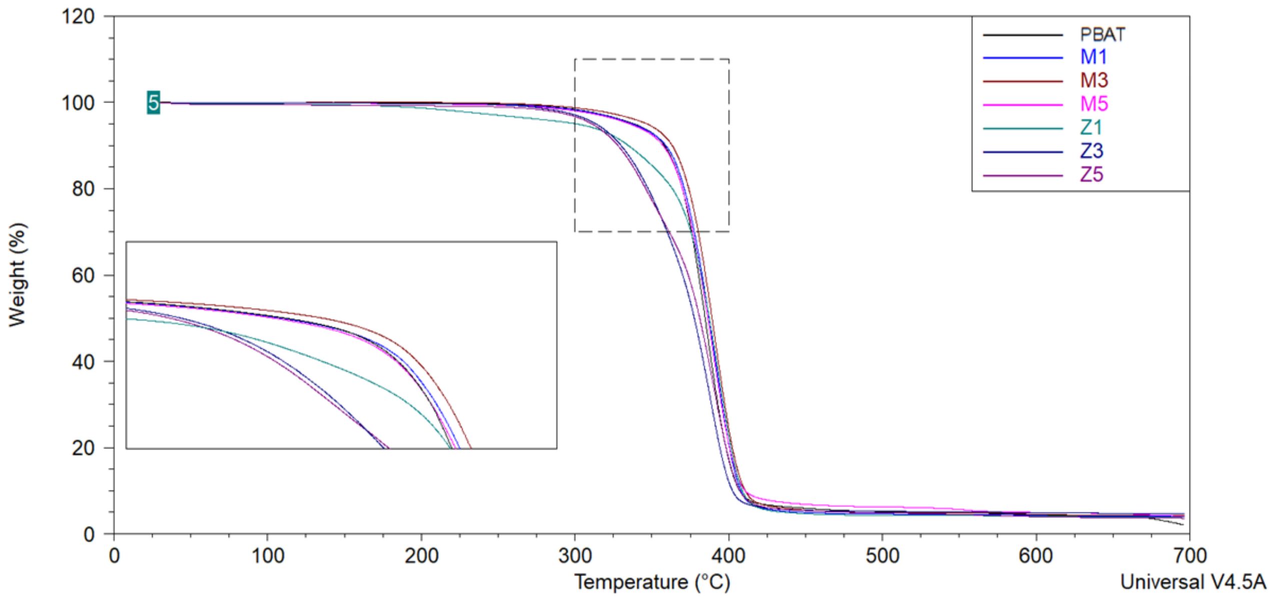
Keywords: Biodegradable Nanocomposites, PBAT, MoO3 And ZnO, Active Packaging.

1 DATA FOR THE EDITORIAL BOARD CONFERENCE

FTIR



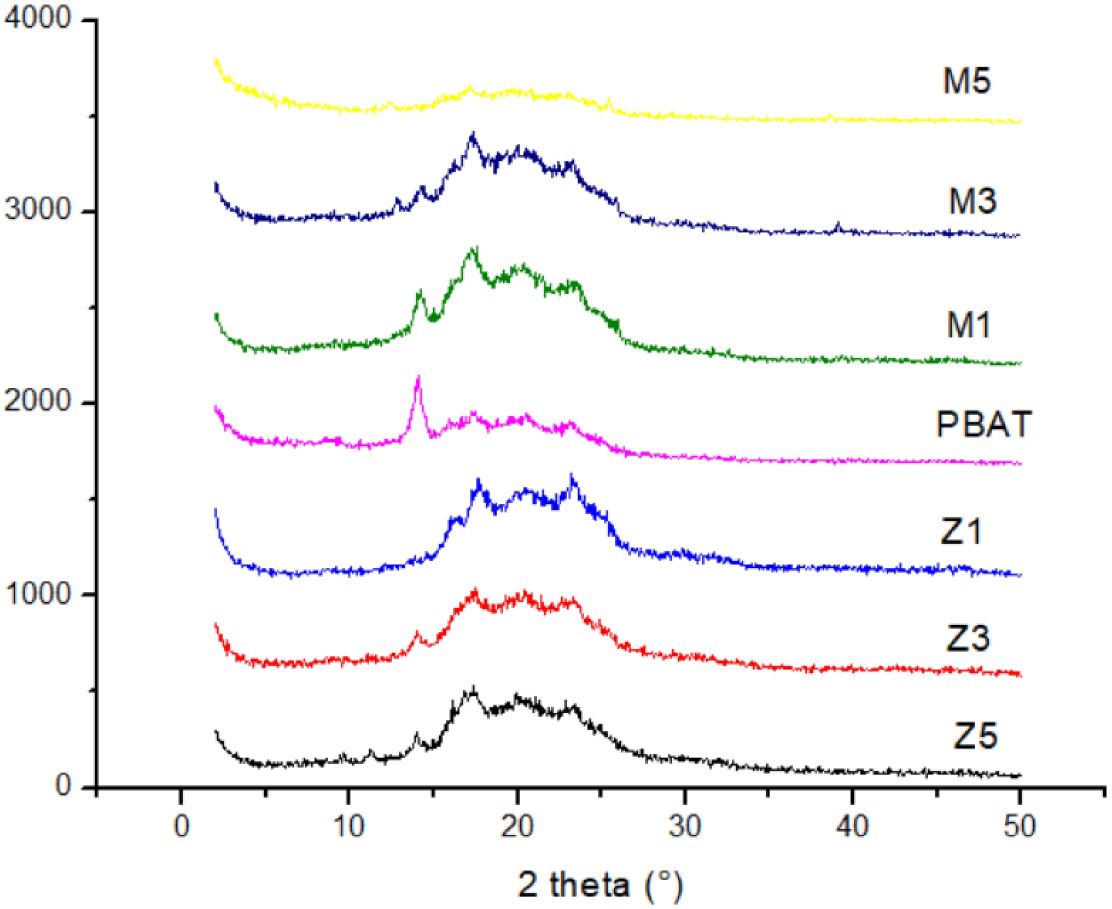
TGA



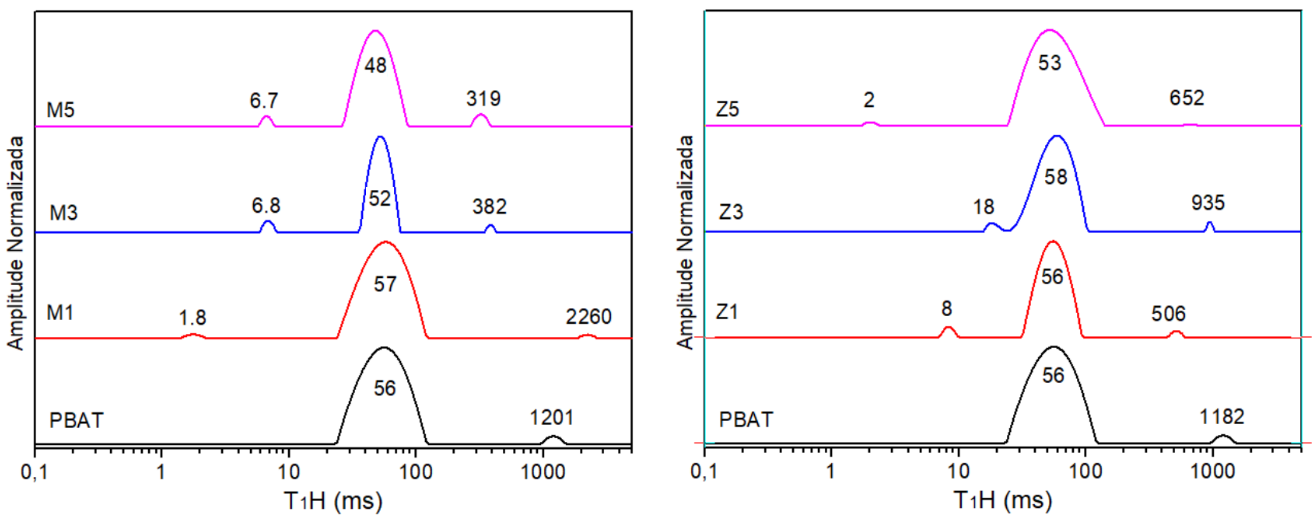
DTGA

	Tonset (°C)
PBAT	364,47
Z1	362,98
Z3	351,89
Z5	350,34
M1	366,14
M3	368,76
M5	364,76

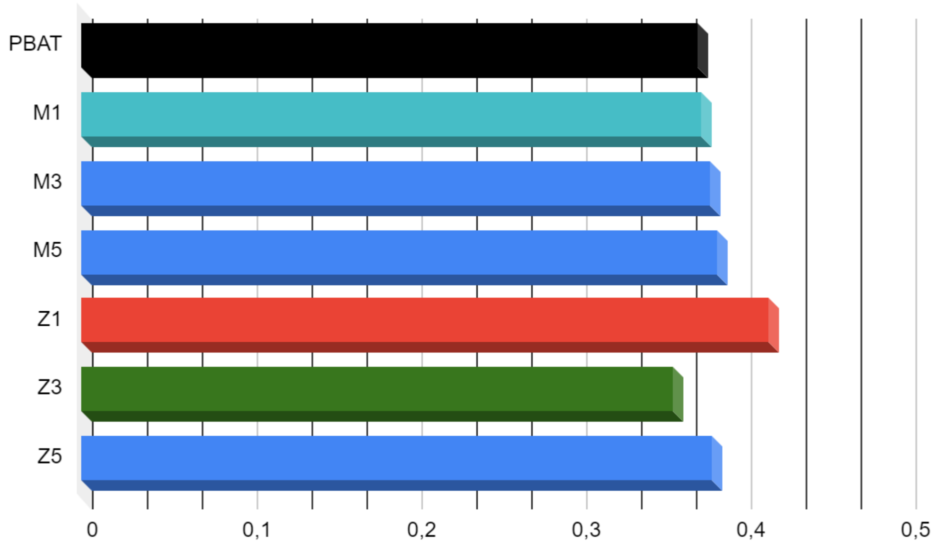
XRD

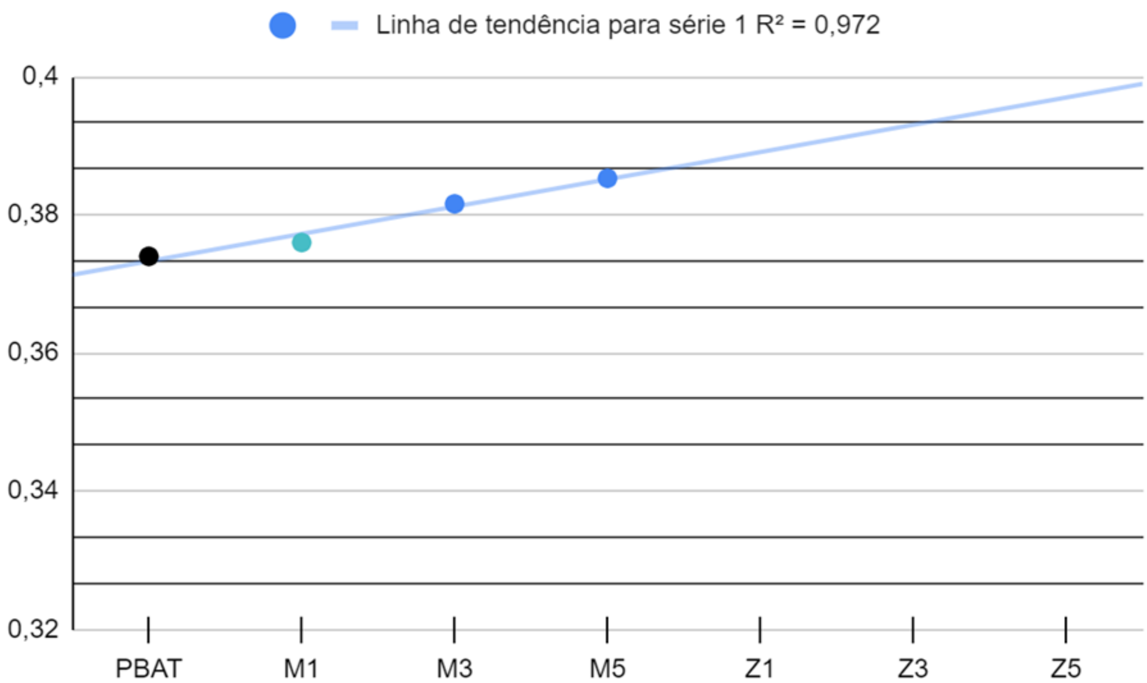

4000
3000
2000
1000
0
M5
M3
M1
PBAT
Z1
Z3
Z5
0
10
20
30
40
50
2 theta (°)

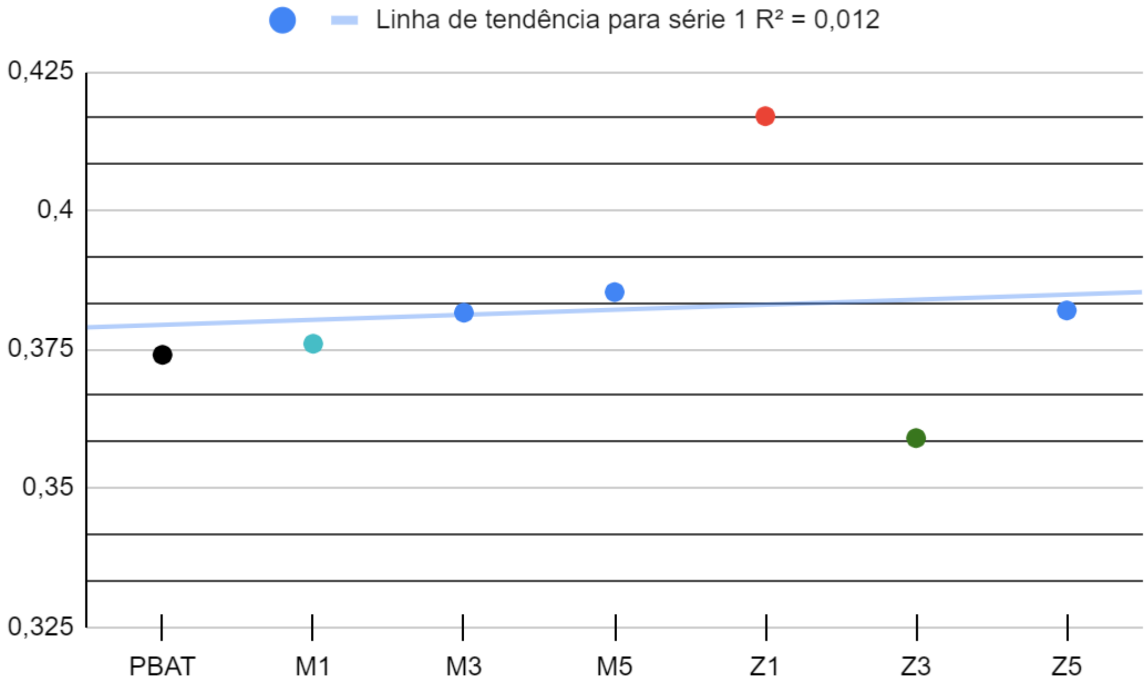
TD-NMR


Amplitude Normalizada
M5
6.7
48
319
M3
6.8
52
382
M1
1.8
57
2260
PBAT
56
1201
0,1
1
10
100
1000
T1H (ms)
Amplitude Normalizada
Z5
2
53
652
Z3
18
58
935
Z1
8
56
506
PBAT
56
1182
0,1
1
10
100
1000
T1H (ms)

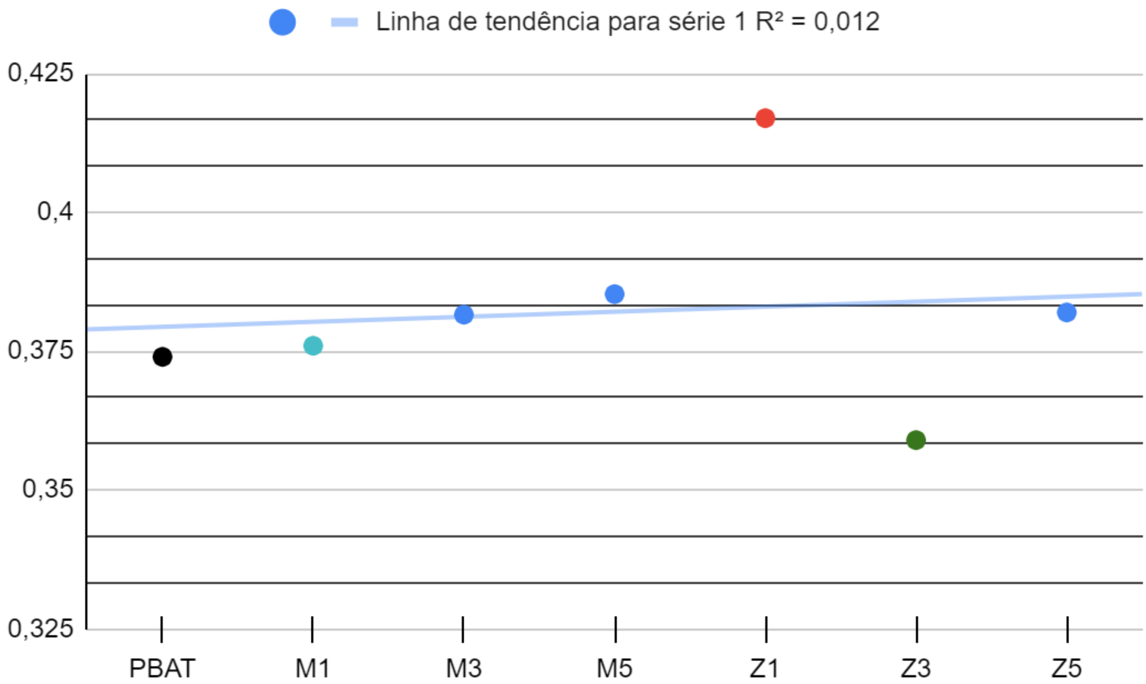
WATER ACTIVITY	
PBAT	0,374
M1	0,376
M3	0,382
M5	0,385
Z1	0,417
Z3	0,359
Z5	0,382







Linha de tendência para série 1 R² = 0,012
0,425
0,4
0,375
0,35
0,325
PBAT
M1
M3
M5
Z1
Z3
Z5



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PBAT
M1
M3
M5
Z1
Z3
Z5

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