Correction to: Synthesis and characterization of a biopolymer of glycerol and macadamia oil

Osmar Antonio Baldo Pires¹ · Rafael Turra Alarcon¹ · Caroline Gaglieri¹ · Luiz Carlos da Silva-Filho¹ · Gilbert Bannach¹

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In the original publication of the article, the Figs. 6, 7, and 8 are in disagreement with their figure captions. Moreover, in the result and discussion section text the Fig. 6 is called as Fig S2 (vibrational spectroscopy in the infrared region section); Fig. 7 is called as Fig S3 (density, solvent resistance, and dye adsorption section); Fig. 8 is called as Fig. 6; Fig. 9 is called as Fig. 7; and Fig. 10 is called as Fig. 8 [fluorescence, scanning electronic microscopy (SEM) and solid UV–Vis analysis section]. Besides, Figs. 9 and 10 are cited in the text (as Figs. 7 and 8); however, they are not shown in the article.

The correct versions are given below [Figs. 6–10 with their respective figure captions and the correct text of vibrational spectroscopy in the infrared region, density, solvent resistance, and dye adsorption and fluorescence, scanning electronic microscopy (SEM) and solid UV–Vis analysis section].

Vibrational spectrometry in the infrared region

The infrared spectra of the pre-polymer, macadamia oil, and macadamia polymer are shown in Fig. 6a–c, respectively.

After the reaction between glycerol and maleic anhydride, the formation of pre-polymer occurs and its infrared spectrum can be seen in Fig. 6a. The reaction occurs through the consumption of OH and loss of H of C–H groups of glycerol (peaks 3346, 1040, and 1115 cm^{-1} for OH; 2935 and 2880 cm^{-1} for C–H) and the consumption of anhydride carbonyls (1778 and 1852 cm^{-1}). Thus, the pre-polymer has a structure of a conjugated ester, presenting the peaks 1708 (carbonyl stretching) and 1204 and 1156 cm^{-1} [ester conjugation, C–C(C=O)–O] and maintaining the unsaturation of anhydride (C=C stretching at 1638 cm^{-1} and C–H binding out of plane at 815 cm^{-1}) [13, 14, 38].

In the macadamia oil spectrum (Fig. 6b), the characteristic peaks are 1743 cm^{-1} that correspond to C=O stretching of ester groups. The sequence of three peaks at 2853, 2922, and 3009 cm^{-1} indicates the C–H bond stretching of CH_2 groups. The peaks at 1649 and 720 cm^{-1} are due to unsaturations in the oil (C=C stretching and C–H binding out of plane, respectively) [13, 14, 38].

Finally, in Fig. 6c, note the disappearance or the decrease in some pre-polymer peaks, especially at 1638 cm^{-1} (C=C of anhydride), suggesting “ene” type reactions during polymerization and the arising of the same major peaks of macadamia oil (1743, 2853, 2922, and 3009 cm^{-1}). The rearrangement of double bonds in the ene reaction leads to a reduction in the intensity of the peaks related to the unsaturations remaining of the macadamia oil (1649 and 720 cm^{-1}) [13, 14, 38].

The original article can be found online at
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✉ Gilbert Bannach
gilbert@fc.unesp.br

¹ Chemistry Department, School of Science, São Paulo State University (UNESP), Bauru, SP 17033-260, Brazil

Fig. 6 FTIR spectra of **a** *pre-polymer*, **b** macadamia oil and **c** macadamia polymer

Density, solvent resistance, and dye adsorption

Using Archimedes principle, the polymer density was determined in triplicate [22]. The found density was $1.32 \pm 0.01 \text{ g cm}^{-3}$.

In solvent resistance tests, the polymer presents the results in Table 2.

Water and toluene solubilized a small part of the material, followed by ethyl acetate and finally by ethanol, which is the only one capable of attacking a considerable part of the polymer. Briefly, the sequence of resistance is: water > toluene > ethyl acetate > ethanol. These results show that the macadamia polymer can be used in aqueous and nonpolar mediums.

To explore a potential application, a qualitative test of organic dye adsorption was made. The selected compounds were rhodamine, fluorescein, methylene blue, and malachite green (all solution concentrations of $1 \times 10^{-3} \text{ mol L}^{-1}$). Figure 7 compares the dye solutions with a mixture of dyes and 50 mg of macadamia polymer after 48 h of rest.

The solutions adsorbed all dyes well, which indicates a strong interaction of the polymer surface and the particles in solution. That result does not explain the interactions presenting between polymer surface and molecules of dye in solution, but demonstrates that it is possible to incorporate organic molecules into the polymer surface. Since macadamia oil and glycerol are edible substances, a promising application for the macadamia polymer is the incorporation of molecules with pharmacological and nutritional interests that are unstable in the isolated form such as anthocyanin and others antioxidants.

Fig. 7 Visual analysis of dye adsorption by the macadamia oil polymer with solutions of **a** rhodamine, **b** fluorescein, **c** methylene blue, and **d** malachite green

Fluorescence, scanning electronic microscopy (SEM) and solid UV–Vis analysis

Figure 8 shows the macadamia polymer without and with exposure to ultraviolet radiation, to illustrate the fluorescent capability of the material.

Fig. 8 Macadamia polymer **a** without and **b** with ultraviolet radiation

The SEM analysis in Fig. 9 presents the surface pattern of the polymer.

Figure 9 illustrated that the macadamia polymer surface is very irregular and rough. This surface profile tends to lead to high superficial areas and a substantial interaction with molecules in solution as demonstrated in the dye adsorption tests.

Figure 10 provides the UV/Vis spectra of macadamia oil and the synthesized polymer.

The oil spectrum (Fig. 10a) presents absorption from 250 nm, and at 310 nm, it begins to fall to zero, with a small increment at 410 nm. In the case of the (Fig. 10b) polymer, the pattern is the same until 330 nm, where a pronounced peak appears with maximum at 363 nm, which is the absorption responsible for the fluorescence of the material.

Fig. 9 SEM analysis for macadamia polymer in magnification of **a** $\times 150$, **b** $\times 350$, and **c** $\times 500$

Fig. 10 UV–Vis spectra of **a** macadamia oil and **b** polymer