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Short communication

Evaluation of latex from five *Hevea* clones grown in São Paulo State, Brazil

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Abstract

Membranes of latex extracted from five clones of rubber tree (*Hevea brasiliensis* (Willd. ex Adr. de Juss) Muell.-Arg.) improved by selection and statistics methods have been prepared by air drying a 10% suspension in ammonia solution. TG–DTG and DSC, were used to characterize the membranes. The results obtained show no differences among latex from different clones.

Keywords: Latex; Clone; Genetic improvement; Thermal decomposition; Thermal stability

1. Introduction

The rubber tree, which is extensively cultivated in southeast Asia, is indigenous to the Amazon Basin of South America. The economic product of the tree is latex (a cytoplasmic fluid from the laticiferous cells), which can be continually extracted from the tree by repeatedly slicing off a thin layer of bark, a process called “tapping” [1].

Brazilian rubber trees were first introduced into São Paulo State, Brazil in 1942. The primary breeding objective is improvement of yield which has achieved great success in Agronomic Institute (IAC) in Campinas city, São Paulo, Brazil [2–4].

Experimental plantations of three IAC clones and two Asiatic clones were used in the study of the physical and chemical characteristics of the latex product. Characterization of the quality of latex is important for quantitative evaluation of rubber production.

2. Experiment method

Latex was extracted from 10 trees of each of five *Hevea* clones. Ten milliliter of concentrated ammonia, was added to 100 ml of the latex to avoid coagulation during transport [5,6]. Membranes of latex were prepared by drying the ammonia solution with an air stream [7].

TG–DTG and DSC curves of latex membranes of clones: IAC-40, IAC-300, IAC-301 grown in Votuporanga, and the matrix Asiatic GT1 and RRIM 600 grown in Pindorama and Votuporanga, were obtained in two thermoanalyser systems: Shimadzu equipment, model TGA-50 and Netzsch equipment, model TA-4, with continuous air flow at a rate of 100 ml min^{-1}. Sample mass 4–11 mg in alumina crucibles without

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covers (aluminium for DSC in Netzsch equipment), at a heating rate of 10 °C min^{-1}. TG data were taken up to 900 °C and DSC data up to 650 °C. No significant differences were noted between data taken with the different instruments.

3. Results and discussion

Table 1 presents temperature range, mass losses, attribution and mass of residue for all latex membranes studied. Typical TG and DTG curves are shown in

Table 1
Thermal stability and mass loss (in %)

Clones/locations	Temperature range (°C)	Mass loss (%)	Attribution	Residue (%)
GT1/Pindorama	27–199	2.0	Volatile	
	199–542	95.4	Thermal decomposition	2.5
GT1/Votuporanga	27–210	1.9	Volatile	
	210–553	97.5	Thermal decomposition	0.5
RRIM 600/Pindorama	27–196	1.6	Volatile	
	196–552	97.8	Thermal decomposition	0.5
RRIM 600/Votuporanga	27–228	1.2	Volatile	
	228–539	98.6	Thermal decomposition	0.1
IAC-40/Pindorama	27–205	1.6	Volatile	
	205–552	97.8	Thermal decomposition	0.5
IAC-300/Votuporanga	27–193	1.8	Volatile	
	193–536	97.2	Thermal decomposition	0.9
IAC-301/Votuporanga	27–210	1.4	Volatile	
	210–533	97.8	Thermal decomposition	0.6

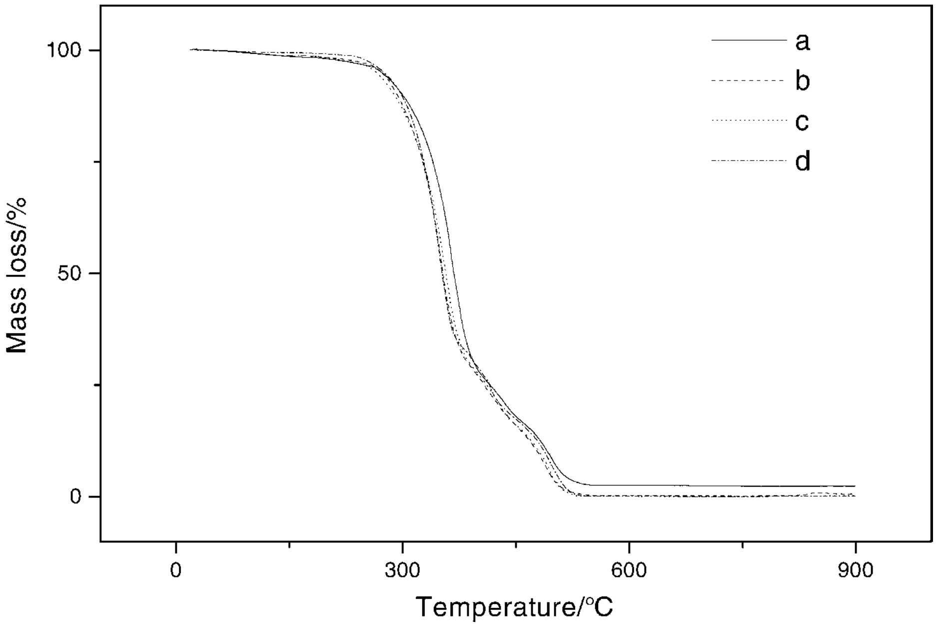

Fig. 1. TG curves of (a) GT1/Pindorama (7,294 mg), (b) GT1/Votuporanga (5,294 mg), (c) RRIM 600/Pindorama (7,786 mg) and (d) RRIM 600/Votuporanga (6,104 mg) clone, respectively, in Shimadzu equipment.

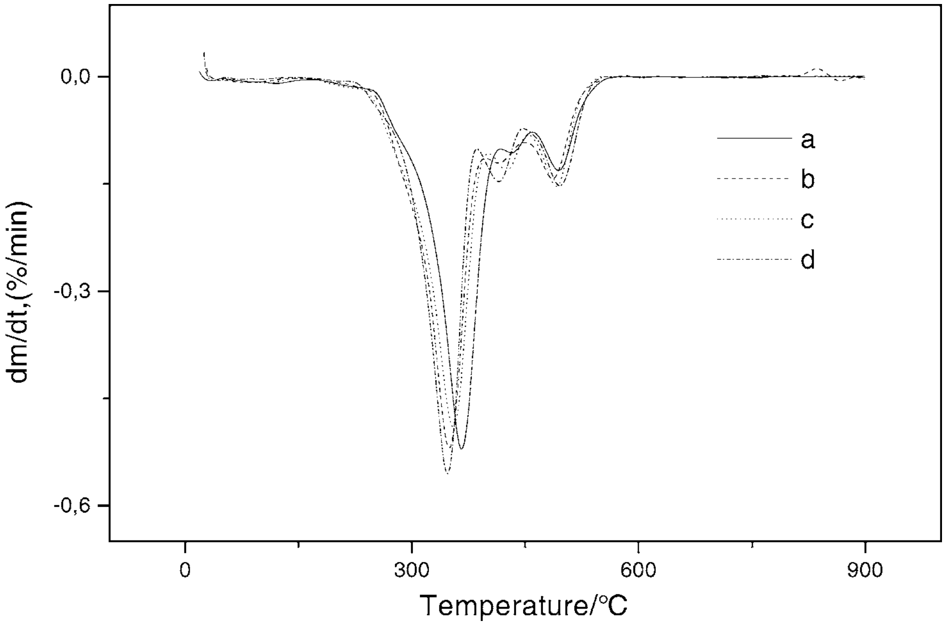

Fig. 2. DTG curves of (a) GT1/Pindorama, (b) GT1/Votuporanga, (c) RRIM 600/Pindorama and (d) RRIM 600/Votuporanga clone, respectively, in Shimadzu equipment.

Figs. 1 and 2. All the membranes lost mass in three consecutive steps, beginning at temperatures between 193 and 228 °C, with TG and DTG curves showing great similarities between sources, suggesting that the decomposition mechanism is the same. The end of thermal decomposition occurs at temperatures up to 553 °C. The residues are probably ashes [8] or impurities, which were added during the extraction process of the latex in the plantations.

Latex from all sources exhibited an initial small mass loss attributed to elimination of the volatile compounds, probably ammonia residue [8], followed by three consecutive mass losses, attributed to thermal decomposition of the membrane.

Table 2 presents temperature range, temperature of maximum peak and heat from the DSC curves (Fig. 3). The DSC curves all exhibited a broad exotherm corresponding to the first steps of thermal decomposition,

Table 2
Temperatures range, temperature of maximum peak and heat

Clones/locations	Broad exotherm			Exothermic peak		
	Temperature range (°C)	Temperature maximum (°C)	Heat (kJ/g)	Temperature range (°C)	Temperature maximum (°C)	Heat (kJ/g)
GT1/Pindorama	228–404	357	1.44	404–554	491	3.12
GT1/Votuporanga	215–398	357	1.77	398–359	485	3.14
RRIM 600/Pindorama	222–400	348	1.58	400–559	488	2.96
RRIM 600/Votuporanga	217–374	335	1.11	374–567	484	2.27
IAC-40/Votuporanga	227–395	365	0.95	414–541	495	2.27
IAC-300/Votuporanga	218–398	354	1.58	398–540	482	2.62
IAC-301/Votuporanga	230–391	365	1.23	361–537	486	3.01

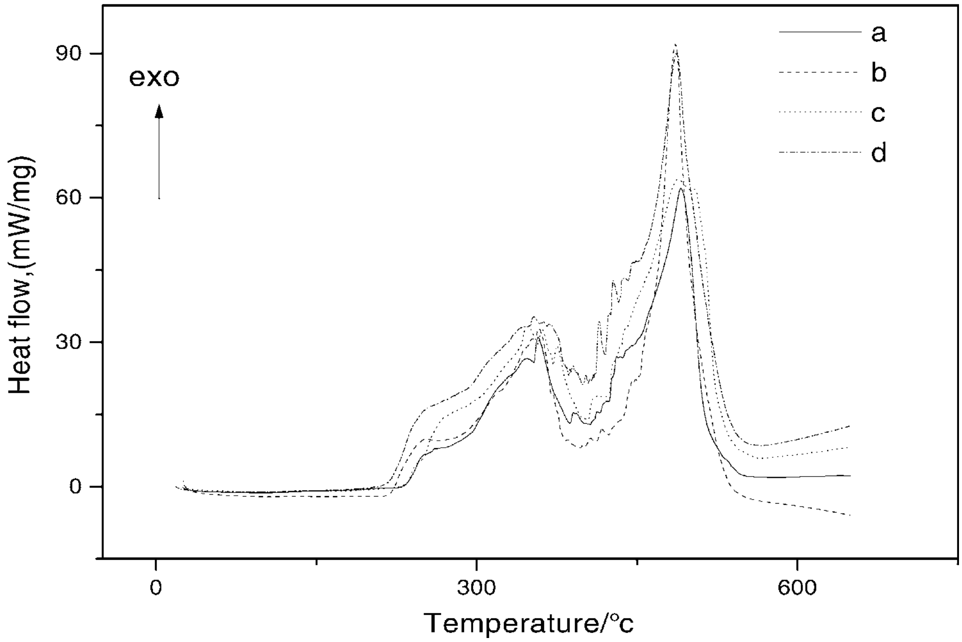

Fig. 3. DSC curves of (a) GT1/Pindorama (5560 mg), (b) GT1/Votuporanga (7000 mg), (c) RRIM 600/Pindorama (7808 mg) and (d) RRIM 600/Votuporanga (7688 mg) clone, respectively, in Shimadzu equipment.

followed by an exothermic peak attributed to the second and the third steps of the process of thermal decomposition. All are in accordance with the mass losses of the TG and DTG curves.

4. Conclusions

The TG–DTG and DSC data for membranes in two different preparations and in two distinct instruments equipment, show that latex from clones of series IAC have similar thermal stability to that observed for latex from clones of Asian origin. The same behavior is observed during thermal decomposition. This information is important because it allows prediction of temperatures for latex manufacture without risk of decomposition.

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References

[1] M.V. Boock, P.S. de Gonçalves, N. Bortoletto, A.L.M. Martins, Herdabilidade, variabilidade genética e ganhos genéticos para produção e caracteres morfológicos em progênies jovens de seringueira, Pesquisa Agropecuária Brasileira (Brasília) 30 (5) (1995) 673–681.

[2] R.B. Costa, M.D.V. Resende, P.S. de Araujo, N. Bortoletto, Seleção combinada univariada e multivariada aplicada ao melhoramento genético da seringueira, Pesquisa Agropecuária Brasileira (Brasília) 32 (2) (2000) 381–388.

[3] P.S. de Gonçalves, O.C. Bataglia, W.R. Santos, A.A. Ortolani, I. Segnin Jr., E.H. Shikasho, Growth trends, genotype–environment interaction and genetic gain in 6-year-old rubber tree clones (*Hevea*) in São Paulo State, Brazil, Genet. Mol. Biol. 21 (1) (1998) 115–122.

[4] P.S. de Gonçalves, N. Bortoletto, E.L. Furtado, Sambugaro, O.C. Bataglia, A.A. Ortolani, Desempenho de clones de seringueira da série IAC-300 selecionados para a região noroeste do estado de São Paulo, Pesquisa Agropecuária Brasileira (Brasília) 36 (4) (2001) 589–598.

[5] E.V., Thomas, M.G. Kumaran, R. Kothandaraman, in: Y. Radhakrishna Pilla (Ed.), Handbook of Natural Rubber Production in India, 1st Edition, Rubber Research Institute of India, Kottayam, 1980 (Chapter 20).
[6] L. Varghese, N.N. Radhakrishna, M.G. Kumaran, in: P.J. George, C. Kuruvilla Jacob (Eds.), Natural Rubber: Agromanagement and Crop Processing, 1st Edition, Rubber Research Institute of India, Kottayam, 2000 (Chapter 20).
[7] L.J. Keddie, Film formation of latex, Mater. Sci. Eng. 21 (1997) 101–170.
[8] H. Cui, J. Yang, Z. Liu, Thermogravimetric analysis of two Chinese used tires, Thermochim. Acta 333 (1999) 173–175.