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DTG AND DTA STUDIES ON FUNGICAL POLYSACCHARIDES

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ABSTRACT

In our work on extracts from various species of fungi, thermal decomposition of polysaccharides model compounds were studied in order to show the correlation between macromolecular structure and thermal stability and to demonstrate their value as auxiliary method in taxonomy. DTG and DTA thermograms were registered in air at a heating rate of 10ºC/min.

In the DTG curves of these extracts the main thermal decomposition process takes place at a maximum rate in the range 263–355ºC, followed by a second process at 438–560ºC. Equally useful for purposes of characterization were the DTA curves, through the analysis of the intensity of their peaks at 330, 390, 435, 480 and 530ºC.

INTRODUCTION

The cell wall of fungi is a complex and multilayered structure formed by, at least, two major polysaccharides. These major polysaccharides have been used as a taxonomic criterion for fungi, as some of them contain chitin-glucans, and others, glucomannans.

In our work on extracts from various species of fungi, thermal decomposition of polysaccharides model compouns were studied in order to show the correlation between macromolecular structure and thermal stability and as aids in the taxonomic identification for such fungi.

EXPERIMENTAL

Studies on wall and F1, F1AS and F1NS polysaccharide fractions have been performed in E. crustaceum, E. stolkiae, G.viride, P. allahabadense, P. digitatum, P. spinulosum, T. thomii, T. helicus, T. flavus and C. albicans.

Maintainance media, culture media, preparation of cell walls, isolation of polysaccharide fractions and chemical analysis have been reported by J.A.Leal and col. (1).

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Thermograms of walls and polysaccharidic fractions were registered using a Perkin-Elmer 3600 and the DTA 1700. Instrument calibration was performed by a standard Indium sample. The material (approximately 5 mg) was weighed in Platinum (TG) or Al_2O_3 crucibles (DTA). Ignited alumina was used as the reference material. The atmosphere was static air and the heating rate of 10ºC/min.

RESULTS

In the DTG curves of the studied extracts, the main thermal decomposition process takes place with a maximum rate at above 263-355ºC, followed by a second process at 438-567ºC.

In the first region, clearly distinguished decomposition peaks appeared : at 263-268ºC for β-galactoglucans, β-mannoglucans or β-(1-3)glucans ; at 280-290ºC for β-galactans, mannans or β-(1-6)-glucans; at 295-328ºC for β-glucogalactans or α-glucans; at 355ºC for chitin. In the DTG curve of mannoglucans a shoulder at 302ºC of the peak at 267ºC affords the characterization of these polysaccharides with regard to galactoglucans. The same feature is showed by the maxima at 288ºC and 311ºC of both β-(1-6)-glucans and chitin -glucans with shoulders at 322 and 325ºC, respectively (see Table 1).

The DTG maximum indicating the second process was found: at 438ºC in yeast α-(1-3)-glucans; at 482ºC in mannans and β-(1-3)-glucans; at about 490ºC in β-galactans[1] and β-glucogalactans; and near 550ºC in β-galactoglucans and β-manoglucans.

Equally useful for purposes of characterization were the DTA curves through the analysis of the intensity of their peaks at 316-342ºC, 388ºC, 425-458ºC, 470-489ºC and 500-540ºC. Basically, the resolution of certain peaks in relation to others leads to the characterization of the family to which they belong (see Figs. 1) . Thus, the glucans can be differentiated from galactans and mannans because the apparition of one of their exothermics at about 430ºC instead of at around 475ºC, as in the case with the latter[2]. The elucidation between galactans and mannans is attained with the higher intensity of 330ºC peak in the glycans with mannosyl units than in those that exhibit galactosyl units. This same exothermic effect at 330ºC leads also to the differentiation between β and α-glucans since in the latter appears with higher intensity than in the former.

[1] *At 472ºC in agarose type II, at 480ºC in agar*

[2] *At 491ºC in agar*

TABLE 1

Characteristic DTG peaks (in ºC) of fungical polysaccharides (in static air and at rate of 10ºC/min).

Polysaccharides	Peak assignment					
	A	B	C	E	F	G
α-glucans α-(1-3)		328		438		
"α-(1-3) & (1-4)*		299-327				513-525
β-galactans		280			482-497	
mannans		290			481	
β-glucogalactans		295		459	496-508	
β-galactoglucans	264-268					550
β-mannoglucans	267	302sh				547
β-glucans β-(1-6)		288	(322sh)	460		
" β-(1-3)	263	(332)			484	
chitin			355			567
chitin-glucans		311	(325sh)			520

TABLE 2

Characteristic DTA peaks (in ºC) of fungical polysaccharides (in static air and at rate of 10ºC/min). Exothermic effects.

Polysaccharides	Peak assignment						
	A	B	C	D	E	F	G
α-glucans α-(1-3)		328		(380)	432		
"α-(1-3) & (1-4)*	260-274	330-342			425-441		492-535
β-galactans	270-285	322-328				470-481	
mannans	285-290	335				474-480	
β-glucogalactans	280-295	316-330			447-458	489	531
β-galactoglucans	285-290	330-335			446		528
β-mannoglucans	268-273	336					507
β-glucans β-(1→6)	(287)	319		(385)	449		
" β-(1→3)		322	(352)				500
chitin			348	388			540
chitin-glucans		330		388			490-500

*Nigerans

The coexistence of glucosyl and galactosyl units in the reported β-galactoglucans and β-glucogalactans polysaccharides is evidenced by the significative increase of the peaks above 430ºC at difference of mannoglucans that only exhibit a solitary, broad and moderate effect at these temperatures. The registra of chitin and chitin-glucans show a peak entirely specific at 388ºC (Table 2).

Finally, the enthalpy variations associated to the exothermic effects to which we have formerly referred to, can also be used with elucidative ends for the distinction among the main glycans family members: in mannans and glucans the areas of the peaks under and above ≃400ºC generally are equivalent, while in β-galactans, β-(1-3)-glucans and chitin the enthalpy of the effects at higher temperatures are higher than those registered at lower temperatures (Fig. 1).

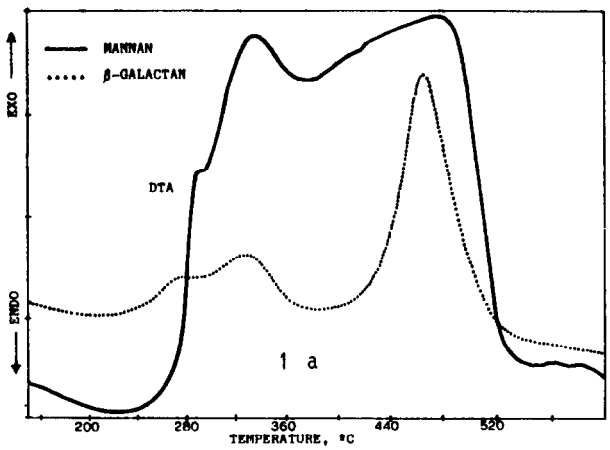

Fig. 1a

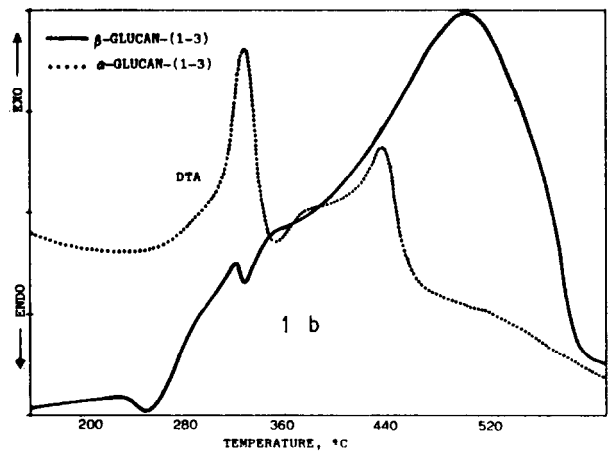

Fig. 1b

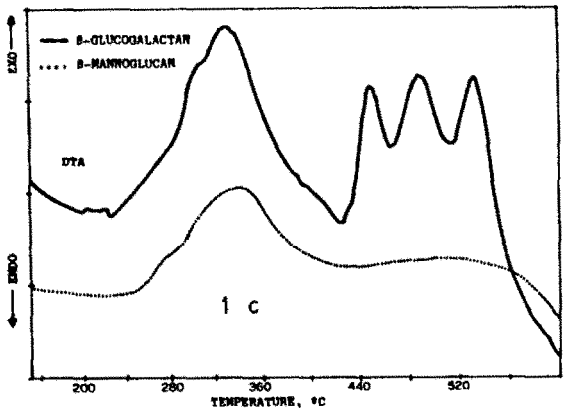

Fig. 1c

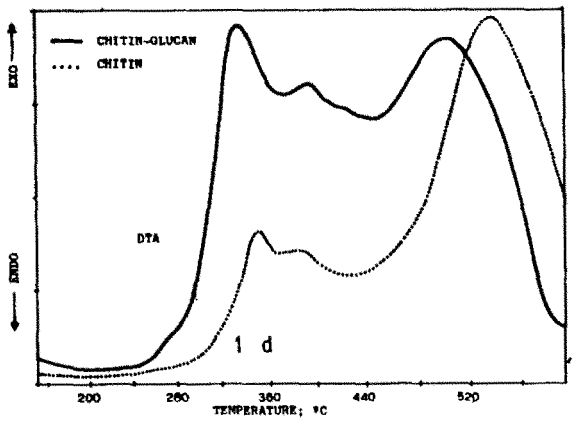

Fig. 1d

Fig.1.DTA curves of: 1a) β-Galactan and Mannan, 1b)β-Glucan-(1-3) and α-Glucan-(1-3), 1c)β-Glucogalactan and β-Mannoglucan, d) Chitin and Chitin-glucan.

All this, we think, points to the fact that the chemical composition and the degree of inter and intramolecular crosslinks of the studied polysaccharides significantly influence their thermal stability so that the DTG and DTA curves could be suitable for identifications aims.

REFERENCES

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