Egypt.J.Anal.Chem.,Vol. 19,PP. 111-115 (2010)

Thermal Analysis of Some Anti-Diabetic Pharmaceutical Compounds

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Summary: Thermal analysis of some interesting antidiabetic compounds was achieved. Thermogravimetry, derivative thermogravimetry (TG, DTG) and differential thermal analysis (DTA) were used to study the thermal behavior of pioglitazone hydrochloride, rosiglitazone maleate, glibenclamide and glimepiride. The results obtained are useful for the identification of these compounds, with special reference to their stability and also permitted interpretations concerning their thermal decomposition**.**

Introduction

The most widely used techniques are differential thermal analysis (DTA), and thermogravimetry/derivative thermogravi-metry (TG/DTG). Several methods have been reported for the determination of the studied drugs including chromatographic (1-4), electrochemical (5-7) and titrimetric (8-9) methods

The main objective of this study is to investigate the thermal behavior of pioglitazone hydrochloride (PTZ**)**, rosiglitazone maleate (RGZ)**,** glibenclamide (GBD) and glimepiride (GMP) raw materials using the TG , DTG and DTA techniques.

Experimental

Instrumentation

The measurements were made with simultaneous DTA-TG apparatus thermal analyzer (Shimadzu DTG -60). The weight of samples is ranging from 2.2 to about 6.6 mg, using a platinum pan. Measurement were carried out from ambient to 900 ºC in dynamic nitrogen atmosphere with the flow rate of 30 mL min^{-1} and heating rate of 10 ºC min^{-1}. The flow rate was measured using an electron flow meter, (Jack - Scientific, model # ADM1000).

Results and discussion

The TG-DTG and DTA curves of pioglitazone hydrochloride, rosiglitazone maleate, glibenclamide and glimepiride are shown in Figs. (1-5). The TG curves of pioglitazone and rosiglitazone show approximate stability with decomposition in four thermal decomposition stages while glibenclamide and glimepiride show decomposition in three steps. The results obtained from Fig. (5) suggested the following sequence of thermal stability: pioglitazone hydrochloride < rosiglitazone maleate <glibenclamide < glimepiride.

The DTA curve of pioglitazone (Fig. 1) shows a small endothermic peak at 187.13 ^{o}C due to fusion of the drug followed by another one at 252.05 ^{o}C and abroad one at 370.05 ^{o}C. Four exothermic peaks were observed: two small at 220.13 and 270.75 ^{o}C and two sharp peaks at 444.47 and 498.20 ^{o}C corresponding to the third and fourth steps in the DTG curve.

The DTA curve of rosiglitazone (Fig.2) shows an endothermic peak at 124.42 ^{o}C attributed to the melting of the compound followed by another endothermic one at 192.75 ^{o}C and a broad flattened one between 317.05 and 418.08 ^{o}C. Two small exothermic peaks are present at 144.26 and 233.49 ^{o}C and a big one at 556.49 ^{o}C which corresponds to the last step in the TG-DTG curves.

DTA curve of glibenclamide (Fig. 3) shows a sharp endothermic peak at 174.71 ^{o}C due to the melting of the drug which is in agreement with the value obtained from literature (172-174 ^{o}C), this peak is followed by a small and broad endothermic one (196.00-286.60 ^{o}C) which corresponds to the first step in the TG-DTG curves. A small endothermic peak at 350.81 ^{o}C which corresponds to the second step in the TG-DTG curve, is observed. The DTA curve shows a broad exothermic peak at 578.38 ^{o}C which is due the final pyrolysis of the drug and corresponds to the third step in the TG-DTG curve.

The DTA curve of glimepiride (Fig. 4) shows a sharp endothermic peak at 211.68 ^{o}C that corresponds to melting followed by a broad and flat exothermic peak between 220. 25 and 515.78 ^{o}C which is followed by a huge

and broad exothermic peak (515.78- 681.88 ^{o}C) corresponding to the third step in the TG-DTG curve.

By comparing the melting temperatures of the examined compounds obtained by using DTA and those stated in the literature(10), it is clear that the results of the DTA method are comparable with the literature figures and can be used for melting point determination for pioglitazone, rosiglitazone, glibenclamide and glimepiride.

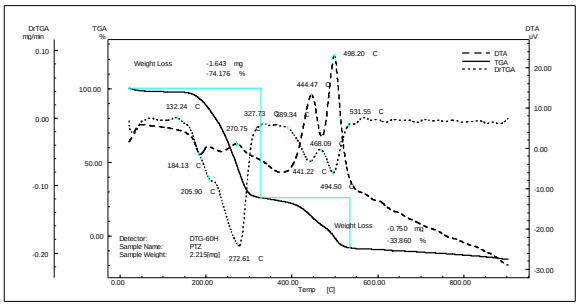

Fig.(1) TG-DTG & DTA for pioglitazone

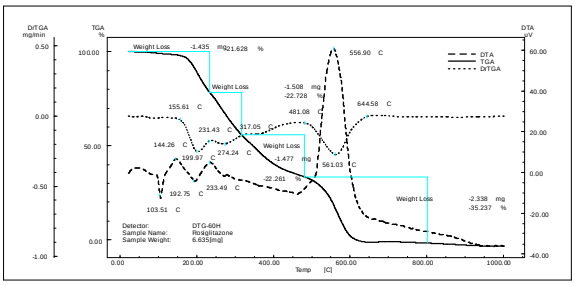

Fig.(2) TG-DTG & DTA for rosiglitazone

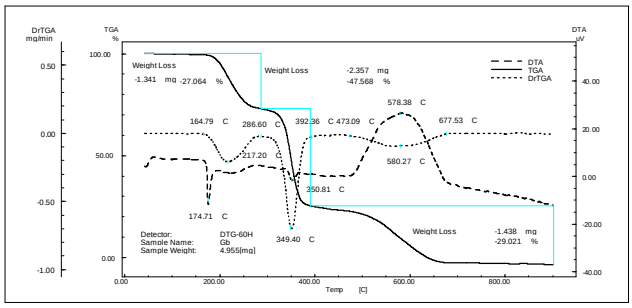

Fig.(3) TG-DTG & DTA for glibenclamide

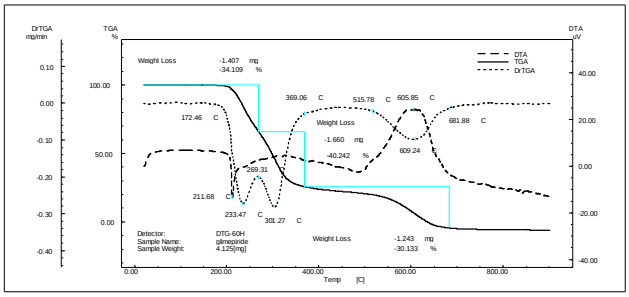

Fig.(4) TG-DTG & DTA for glimepiride

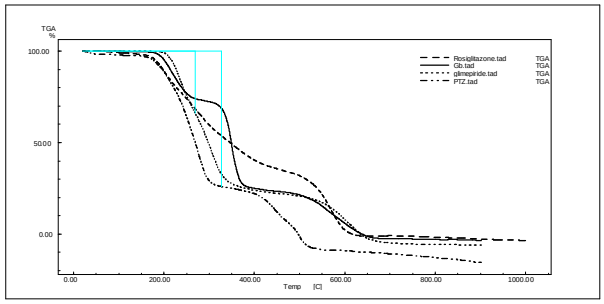

Fig. (5) TG curves for PTZ, RGZ, GBD and GMP

Conclusion

The TG-DTG and DTA curves permitted studies on the thermal stability and the thermal decomposition of some antidiabetic agents. The results demonstrated differences in thermal stability between the four drugs and suggested the following sequence of stability pioglitazone hydrochloride< rosiglitazone maleate <glibenclamide < glimepiride. The results justify the use of DTA as a routine technique for the identification of pioglitazone hydrochloride, glibenclamide and glimepiride, through the melting point.

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