QUANTITATIVE DETERMINATION OF THE FUROCOUMARINS IN THE LEAVES OF Ficus carica

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The leaves of Ficus carica L. contain furocoumarins – psoralen and bergapten [1]. In order to achieve the fullest extraction of the combined furocoumarins from the raw material we have performed a comparative study of various methods of extraction (Table 1) as a result of which we chose extraction in the cold with shaking for 1 h.

As the optimum extractant of the total furocoumarins we used 60% aqueous acetone. This solvent permits the furocoumarins to be extracted to the fullest extent from the raw material in 1 h (Table 2, Fig. 1, where X is the furocoumarin content and τ is the time of extraction).

The plant extract was chromatographed in a thin layer of alumina in diethyl ether in order to separate the total furocoumarins from the ballast substances. The furocoumarins were desorbed from the Al_2O_3 with 95% ethanol. The desorption of the furocoumarins took place almost completely in 1 h (Fig. 2, where τ is the time of desorption).

The total amount of furocoumarins in the eluate was determined on an SF-4 spectrophotometer at λ 298 nm ($E^{1\%}_{1cm}$ for psoralen = $E^{1\%}_{1cm}$ for bergapten). The total furocoumarins were calculated relative to one of the components, and the proportions of psoralen and bergapten were found graphically by the method given previously [2]. The objectivity of the method was checked in experiments with additions of standard samples of psoralen and bergapten. The relative error of the analysis was ± 1.63%. The time of analysis was 3-3.5 h.

Thus, the main difference in the proposed method from the existing method [3] is the use of a more effective extractant, the chromatographic purification of the plant extract from ballast substances, and the

TABLE 1. Comparative Results of the Extraction of the Furocoumarins

Method of extraction	95% ethanol	60% acetone
	total amount of furocoumarins, %	
Hot extraction (two 1-h extractions)	0,52	0,92
Cold extraction (shaking for 1 h)	0,55	0,90
In a Soxhlet apparatus (23 h)	0,59	–

Table 2. Choice of the Optimum Extractant for the Furocoumarins

Extractant	Total amount of coumarins, %
Benzene	0,40
Chloroform	0,44
95% ethanol	0,54
40% ethanol	0,65
Acetone	0,33
20% acetone	0,65
40% acetone	0,90
60% acetone	0,95
80% acetone	0,92

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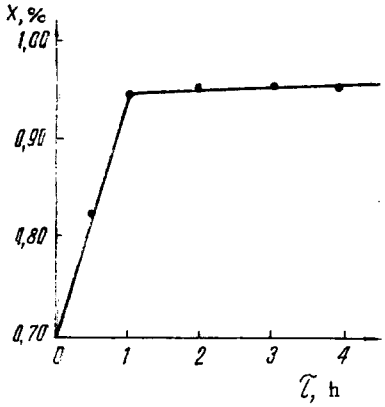

Fig. 1

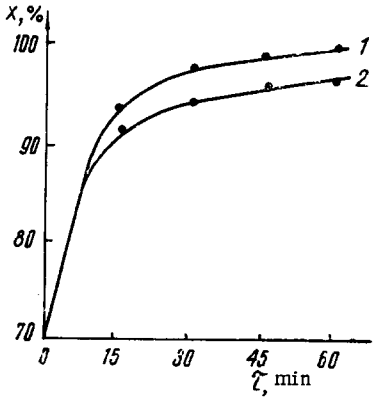

Fig. 2

Fig. 1. Kinetic curve of the extraction by shaking of the total furocoumarins from the leaves of Ficus carica with 60% aqueous acetone (x is the furocoumarin content, %, and τ is the time of extraction).

Fig. 2. Kinetic curves of the desorption of psoralen (1) and of bergapten (2) (x is the furocoumarin content, %, and τ is the time of desorption, %).

simultaneous spectrophotometric determination of the amount of psoralen and bergapten in their mixtures graphically, which has enabled the accuracy and informativeness of the analysis to be substantially increased.

EXPERIMENTAL METHOD

For the extraction of the furocoumarins, 5 g of comminuted and sieved (5-mm apertures) air-dry leaves was covered (1 : 10) with 50 ml of 60% aqueous acetone and the mixture was shaken vigorously for 1 h. On a plate (18 × 24 cm) with a nonfixed layer of Al_2O_3 was deposited 0.1 ml of the filtered extract and a standard solution of one of the furocoumarins, and chromatography was performed in diethyl ether. The plate was dried at 40-50° C for 1 h. The zone corresponding to the Al_2O_3 containing the furocoumarins was determined by its blue fluorescence in UV light (λ 254 nm) and was removed from the plate, and so was an equal area of a zone of the Al_2O_3 without them (background), and these portions of the sorbent were covered with 10 ml of 95% ethanol and left in a thermostat at 50-60° C for 1 h. After the flasks had been cooled to room temperature, the solutions were filtered and the optical densities of the eluates and also of the standard substance relative to the background at λ 298 nm were determined. The percentage of total coumarins was calculated from a known formula [4].

SUMMARY

A new modification of the chromato-spectrophotometric method of determining the amounts of psoralen and bergapten in the leaves of Ficus carica has been developed.

LITERATURE CITED

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