

Cytostatic Activity of Some Phenolic Acids of *Scrophularia frutescens* L. var. *frutescens*

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The cytostatic activity of seven phenolic acids: coumaric, caffeic, ferulic, gentisic, protocatechuic, syringic and isovanillic acid previously isolated from *Scrophularia frutescens* has been evaluated against Hep-2 cells (derived from a human epidermoid carcinoma of the larynx) and McCoy cells (derived from the synovial fluid in the knee joint of a patient suffering from degenerative arthritis). The compounds belonging to the cinnamic group present the highest activity.

Introduction

An extensive bibliography is now available concerning natural products from higher plants which have been tested for their cytostatic activity in animal and plant cells. A great variety of active compounds of natural origin and novel agents isolated from plants have shown antitumoral properties (Gomez *et al.*, 1996).

Different species of the genus *Scrophularia* (Scrophulariaceae) have been used in traditional medicine to treat a wide diversity of diseases, of which dermatosis: scabies, tumors, spong., etc. (Viola, 1966; Font Quer, 1990) and inflammatory affections (Swiatek, 1970) stand out.

Scrophularia frutescens grow in south west Spain and northwest Africa, but in different habitats. We previously carried out a phytochemical and pharmacological study of *Scrophularia frutescens* and the isolation and identification of the several phenolic acids and their antibacterial and anti-inflammatory activity was reported (Fernandez *et al.*, 1996; Garcia *et al.*, 1996).

The aim of this study is to determine the cytostatic effects of seven phenolic acids: *p*-coumaric,

caffeic, ferulic (derivates of cinnamic acid) and gentisic, protocatechuic, syringic and isovanillic (derivates of benzoic acid), isolated from *Scrophularia frutescens* on two cell lines: Hep-2 (derived from a human epidermoid carcinoma of the larynx) and McCoy (derived from the synovial fluid in the knee joint of a patient suffering from degenerative arthritis). With the obtained results we had attempted to establish some structure–activity relationship.

Material and Methods

Plant material

The aerial parts of *Scrophularia frutescens* L. var. *frutescens* were collected in southwest Spain, in Matalascañas (province of Huelva), in March 1997 and were identified by the Botany Department, Faculty of Pharmacy, Sevilla. A voucher specimen was deposited in the herbarium of this Faculty (SEV-F).

Compounds tested

Phenolic acids: *p*-coumaric, caffeic, ferulic, gentisic, protocatechuic, isovanillic and syringic were isolated of a aqueous acid extract from *Scrophularia frutescens* (Fernandez *et al.*, 1996). The selected method was the Lescao technique (Lescao *et al.*, 1972) slightly modified by Marhuenda and Garcia (Marhuenda *et al.* 1985). Dried aerial parts of plant were reduced to powder, boiled in acid water with HCl (pH = 2) for 20 min and filtered. The aqueous solution was treated with diethyl ether and purified through successive changes of pH to give ethereal extract which was evaporated to dryness under vacuum. The dry residue obtained was fractionated by column chromatography on silica-gel 60 (Merck), using different proportions of *n*-hexane/ethyl acetate and ethyl acetate/methanol as solvent systems.

Cytostatic test procedure

The cytostatic activity was determined by measuring the inhibition of the development of a single-layer culture of Hep-2 and McCoy cells (collection of Departement of Microbiology and Parasitology, Faculty of Medicine, University of

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Sevilla), cultivated in Eagle's minimum essential medium (MEM), according to the method described by Geran *et al.* (1972).

Cells were grown in MEM supplemented with 5% of bovine fetal serum and a 2% solution of penicillin (5000 IU/ml) and streptomycin (5000 µg/ml) to pH 7.2 and 36 °C. After distribution in the nutrient medium and when a continuous monolayer culture had been obtained, the samples in the study were sterilized through a filter Millipore 0.22 µm and then inoculated.

Samples were dissolved in a 1% hydroalcoholic solution as vehicle and diluted to give different concentrations. A solution of 6-mercaptopurine (0.5 µg/ml) as a positive control and a blank control were used under identical conditions.

72 h after inoculation of the samples, incubated at 36 °C, the cellular protein concentration was determined to evaluate the inhibitory effect on growth. The colorimetric method of Bradford (1976) was followed, using a calibration gauge with different concentrations of a standard solution of human albumin. Each assay was carried out in triplicate and the average of the reading is documented.

Statistical analysis

Student's t-test was used to compare results against the control group. The values are expressed as mean \pm SE.

Results and Discussion

The results (expressed as ID₅₀ values) obtained on cytostatic activity are summarized in Table I.

Table I. Cytostatic activity (ID₅₀) on Hep-2 and McCoy cells.

COMPOUND	ID ₅₀ [µM/ml]	
	Hep-2 cells	McCoy cells
Caffeic acid	28.55 .10 ⁻³ \pm 0.028	13.61 .10 ⁻³ \pm 0.026
Ferulic acid	17.21 .10 ⁻³ \pm 0.022	7.47 .10 ⁻³ \pm 0.016
<i>p</i> -Coumaric acid	23.17 .10 ⁻³ \pm 0.018	9.88 .10 ⁻³ \pm 0.010
Syringic acid	49.14 .10 ⁻³ \pm 0.041	19.54 .10 ⁻³ \pm 0.029
Genisic acid	203.37 .10 ⁻³ \pm 0.019	126.62 .10 ⁻³ \pm 0.025
Protocatechuic acid	234.67 .10 ⁻³ \pm 0.042	153.90 .10 ⁻³ \pm 0.038
<i>p</i> -OH benzoic acid	212.10 .10 ⁻³ \pm 0.088	97.54 .10 ⁻³ \pm 0.043
Isovanillic acid	161.54 .10 ⁻³ \pm 0.024	31.25 .10 ⁻³ \pm 0.067

All the compounds tested show a higher activity against Hep-2 and McCoy cells. The phenolic acids of the cinnamic group present a ID₅₀ inferior than those recommended by protocols of the National Cancer Institute (N. C. I.) of USA for natural products, 6µg/ml for first stage and 4 µg/ml for second stage, as interesting for further investigations.

However the data obtained with the phenolic acid of the benzoic group show that the ID₅₀ for these samples are highest than those recommended by N. C. I. except the syringic acid (ID₅₀ = 3.87 \pm 0.34) and isovanillic acid (ID₅₀ = 5.25 \pm 0.70) against McCoy cells.

The results are in accord with the popular uses of different species of *Scrophularia* genus, traditionally used in scrofulas, and indicate that some of the phenolic acids assayed may be promising for the therapy malignant skin inflammatory affections; related to this application, we demonstrated previously the antiseptic and antiinflammatory effects of the phenolic acids isolated from this plant.

- Bradford M. M. (1976), A rapid and sensitive method for the quantitation of microgram quantities of protein utilizing the principle of protein-dye binding. *Anal. Biochem.* **72**, 248–254.
- Fernandez M. A., Garcia M. D. and Sáenz M. T. (1996), Antibacterial activity of the phenolic acids fractions of *Scrophularia frutescens* and *Scrophularia sambucifolia* J. *Ethnopharmacology*, **53**, 11–14.
- Font Quer P. (1990), *El Dioscorides renovado*, 12 th Ed. Labor S. A. Barcelona.
- Garcia D., Fernandez M. A., Saenz M. T. and Ahumada C. (1996), Antiinflammatory effects of different extracts and Harpagoside isolated from *Scrophularia frutescens* L. *Il Farmaco* **51**, 443–446.
- Geran R. I., Greenberg N. H., Mac Donald M. M., Schumacher A. M. and Abbott B. J. (1972), Protocols for screening chemical agents and natural products against animal tumours and other biological systems. *Cancer Chemother. Rep.* **3**, 17–79.
- Gomez M. A., Saenz M. T., Garcia M. D., Puerta R. and Ahumada M. C. (1996), Effect of methanolic extract of parasitic *Viscum cruciatum* Sieber on mitosis in *Allium cepa* L. *Cytobios* **85**, 59–63.
- Lescao F., Faugueras G. and Paris R. (1972), Sur divers constituents phenoliques (acides phenols, flavonoids) de l'*Osyris alba*. *Plantes Medicinales et Phytotherapie* **24**(3), 152–157.
- Marhuenda E. and Garcia M. D. (1985), Mise en évidence des sommités fleuries d'*Ononis natrrix* L. Identification de l'acide ferulique. *Plantes Medicinales et Phytotherapie* **19**, 163–172.
- Swiatek L. (1970), Pharmacobotanical investigations on some Scrophulariaceae species. IV. Chemical constituents of the herb of *Scrophularia nodosa*. *Dissertations of Pharmacy and Pharmacology* **22**, 321–328.
- Viola S. (1966), *Plante Médicinale e Velenose de la Flora Italiana*. Maestri, Milán.