

Screening of Irish Fruit and Vegetable Germplasm for Novel Anti-tumour and Pesticidal Compounds

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Introduction

Phytochemicals are a rich source of novel therapeutic and insecticidal agents (McLaughlin and Chang, 1999). Considerable research effort has been directed at screening exotic and medicinal plants in the search for novel products. However, plants which have traditional food uses have been little explored. In addition the range, type and level of individual bioactive compounds can vary significantly between different species, different cultivars of the same species and different tissue types of the plant (Reilly, *in press*) Therefore, the objective of this study was to screen a range of fruits and vegetables which can be grown in Ireland for novel bioactive compounds for use in food production and as bio-pesticides.

Materials and Methods

Crude aqueous extracts from 173 samples of fruit and vegetables were screened using brine shrimp bioassay (BSB). Plant material was separated and blended in a juicer (TESCO®) to get sufficient volume of aqueous extract (20 ml). Samples were centrifuged at 7690 g for 10 minutes and the supernatant was stored at - 20 °C (aqueous extracts). Alternatively plant samples were ground to a fine powder in liquid nitrogen. Five grams of powdered tissue were suspended in 30 ml of aqueous methanol (80% v/v) in a 50 ml tube and mixed using a vortex. Samples were stored at room temperature for 30 minutes and then filtered through Whatman number 1 filter paper. Methanolic extracts were transferred to a rotary evaporator until completely dry. The dried samples were then stored at - 20 °C (solvent extracts). Brine shrimp bioassays (a rapid bioassay for insecticidal and antitumour compounds) were carried out according to McLaughlin and Chang (1999) for all aqueous extracts. Brine shrimp bioassays using methanolic extracts were carried out for the samples which had shown positive preliminary screening of aqueous extracts in BSB. Data for the BSB were analysed using probit analysis (SAS 9.1) to estimate LC₅₀ values and 95% confidence intervals. The potato disc bioassay (PDB) (an anti-tumour bioassay) was carried out according to McLaughlin and Chang (1999) for samples showing positive results from both aqueous and methanolic extracts in BSB. The percent inhibition of crown gall tumours was calculated as outlined below and is considered significant if there is a greater than 20% reduction in galls (McLaughlin and Chang, 1999).

$$\% \text{ Inhibition} = 100 - \frac{\text{Average number tumours of sample}}{\text{Average number tumours of control}} \times 100$$

Results and discussion

Aqueous extracts from beetroot, cranberry, garlic, ginger, red onion and rhubarb showed positive results

(LC₅₀<0.02 v/v) and significant inhibition of crown gall tumours (>20% inhibition) in BSB and PDB respectively (Tables 1 and 2). Methanolic extracts were used in BSB from these 6 positive aqueous extracts. Three methanolic extracts (cranberry, ginger and rhubarb) showed positive lethal concentration (LC₅₀<1000 ppm) in BSB. Methanolic extracts of cranberry and rhubarb showed significant inhibition of crown gall tumours in the PDB (>20%).

Table 1. Summary of positive results of the initial screening using brine shrimp bioassay

Plant name	Tissue	Brine shrimp bioassay (LC ₅₀)	
		Aqueous (Dilution v/v)	Solvent (ppm)
Beetroot	Root	0.0069 ± 0.0034	>1000
Cranberry	Fruit	0.0039±0.00006	29±28.2
Garlic	Bulb	0.0046±0.0003	>1000
Ginger	Rhizome	0.0088±0.00066	110±14.9
Red onion	Bulb	0.0117±0.0015	>1000
Rhubarb	Petiole	0.0043±0.005	52±83.5

± Standard error for the means of three bioassays (n=3)

Table 2. Inhibition of crown gall tumours in the potato disc bioassay

Plant name	Tissue	Potato disc bioassay (% Inhibition)	
		Aqueous (Dilution v/v)	Solvent (ppm)
Beetroot	Root	-25.6 ±12.4	NA
Cranberry	Fruit	-48.3±8.3	- 30 ± 8.5
Garlic	Bulb	-26.7±1.5	NA
Ginger	Rhizome	-53.7±6.3	+15 ± 9.8
Red onion	Bulb	-21.9±3.5	NA
Rhubarb	Petiole	-28.3±11.8	- 41 ± 10.7

*NA: Not applicable

± Standard error for the means of three bioassays (n=3)

Conclusions

The data demonstrate the potential for extraction of antitumour and biopesticidal compounds from 3 traditional Irish fruit and vegetables is comparable to that of 3 fruit and vegetables internationally recognised for beneficial phytochemical production.

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References

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