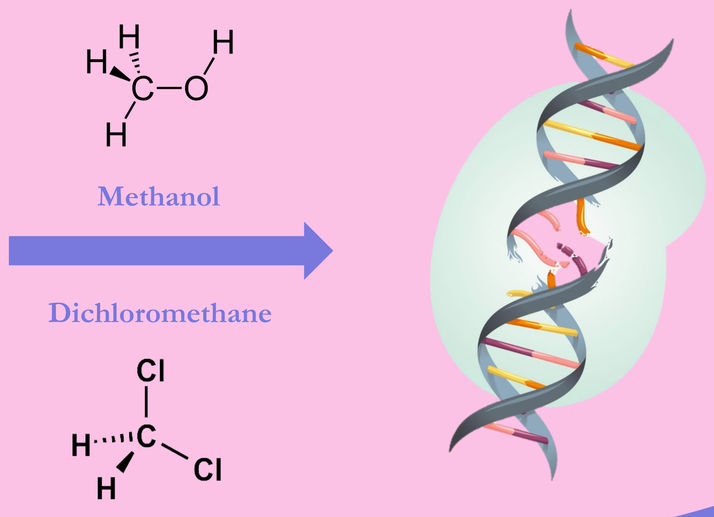
Achillea millefolium L. – a potential anticancer candidate?



Cytotoxic and genotoxic potential of *Achillea millefolium* L. herb methanol and dichloromethane extracts

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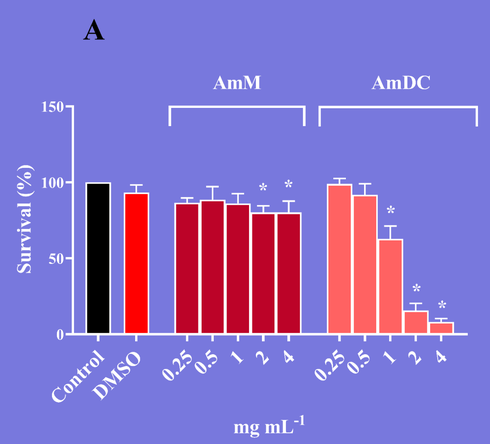

Figure 1. Cytotoxic potential of *A. millefolium* methanolic and dichloremethane extracts on MRC-5 (A), A549 (B) and HCT116 (C) cell lines (*p < 0.05)

Table 1. IC_{50} values determined for *A. millefolium* extracts

IC_{50}	MRC-5	A549	HCT 116
AmM (mg mL^{-1})	>4	1.3	2.6
AmDC (mg mL^{-1})	2.9	0.7	0.7

Table 2. Anticancer selectivity indexes (SI_C) of *A. millefolium* extracts

	SI_C	
	MRC-5 / A549	MRC-5 / HCT 116
AmM (mg mL^{-1})	>3.1	>1.5
AmDC (mg mL^{-1})	4.1	4.1

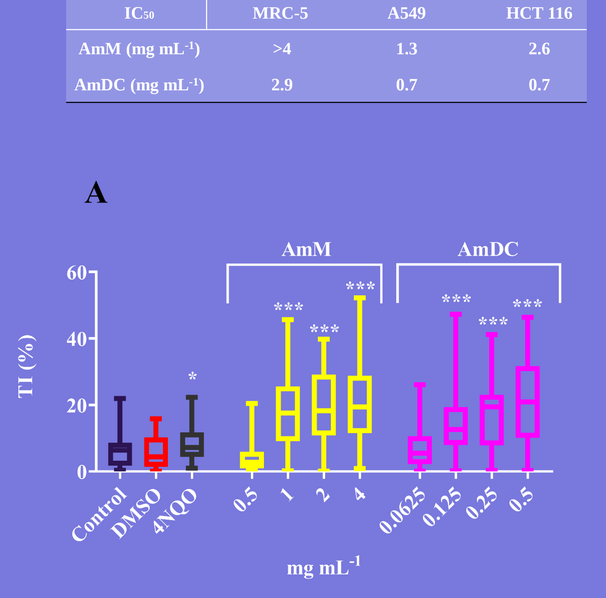

Figure 2. Genotoxic potential of *A. millefolium* extracts on MRC-5 (A), A549 (B) and HCT116 (C) cell lines (*p < 0.05)

Introduction

The problem of rapidly growing chemiotherapeutics resistance worldwide compromises the effectiveness of disease treatment and leads to the constant search for new anticancer agents from natural sources, especially plants. *Achillea millefolium* L. (yarrow) is commonly used in both folk medicine and modern phytotherapy.

Matherials and Methods

Chemical analysis was conducted by quantitative LC–MS analysis for methanol extract and GC-FID and GC-MS analysis for dichloromethane extract. Cytotoxic potential was investigated by MTT assay on lung adenocarcinoma (A549), colorectal adenocarcinoma (HCT116), and normal fetal fibroblast (MRC-5) cell lines. As it is crucial that the potential anticancer agent possesses selective toxicity, anticancer selectivity index (SI_C) was calculated. The genotoxicity was investigated through the alkaline comet assay on the mentioned cell lines.

Results

The results of MTT test highlight the dichloromethane extract as the most potent against all tested cell lines with highest cell viability reduction seen on A549 cells (up to 94 %)(Figure 1.). Genotoxicity, investigated through the alkaline comet assay, revealed that both extracts induced damages on DNA at all tested concentrations in dose-dependent manner, with 23.9% as the highest observed tail intensity (Figure 2.).

Acknowledgement

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Conclusions

- Dichloromethane extract showed highest cytotoxicity effect against all tested cell lines.
- Dichloromethane extract exhibited highest anticancer selectivity index value towards A549 cells (SI > 3).
- Both extracts induced genotoxicity at all tested concentrations in dose-dependent manner.
- Based on the obtained results, *A. millefolium* extracts surface as potential candidates for novel anticancer therapeutics, although additional research into its underlying mechanisms is required.

Table 3. Detected phenolic compounds as well as their quantities [expressed as g/100 g dried MeOH extract (DE)]

Rt (min)	Compound	%, g/100 g DE
10.94	Chlorogenic acid	2.216±0.167[a]
12.11	Caffeic acid derivative	0.064±0.008[b]
18.20	Kaempferol hexosylhexoside	tr.[c]
19.79	Quercetin pentosylhexoside	0.002±0.000
20.17	Hydroxykaemferol hexoside	tr.
21.10	Quercetin 7-*O*-rutinoside	0.190±0.026
21.50	Apigenin hexosylhexuronide	0.032±0.002
21.80	Luteolin 7-*O*-rutinoside	0.026±0.001
22.17	Quercetin 3-*O*-glucoside	0.079±0.005
22.86	Luteolin 7-*O*-glucoside	2.126±0.013
23.04	Luteolin 7-*O*-glucuronide	0.443±0.007
23.34	Methylquercetin hexoside	tr.
23.80	1,3-di-*O*-caffeoylquinic acid	0.394±0.013
24.15	Apigenin 7-*O*-rutinoside	0.084±0.008
24.60	3,4-Di-*O*-caffeoylquinic acid	0.999±0.018
25.06	3,5-Di-*O*-caffeoylquinic acid	7.839±0.058
25.06	Di-*O*-caffeoylquinic acid isomer 1	1.782±0.025
25.55	Apigenin 7-*O*-glucoside	1.572±0.010
25.94	1,5-Di-*O*-caffeoylquinic acid	3.497±0.023
26.49	Luteolin hexoside derivative	tr.
26.94	Luteolin acylhexoside	tr.
27.47	Di-*O*-caffeoylquinic acid isomer 2	0.578±0.011
28.28	Luteolin acylhexoside	0.001±0.000
28.53	Apigenin acylhexoside	tr.
29.12	Apigenin acylhexoside	0.058±0.001
29.44	Apigenin acylhexoside	0.062±0.002
29.70	Luteolin	0.186±0.006
31.70	Apigenin	0.283±0.009

Table 4. Phytosterol and triterpene composition of unsaponifiable fraction of AmDC

Rt	Compound	%
78.23	Campesterol	6.8 ± 0.2
79.15	Stigmasterol	5.7 ± 0.1
80.66	*β*-Amyrin	11.8 ± 0.0
81.02	*β*-Sitosterol	18.8 ± 0.5
82.20	*α*-Amyrin	22.2 ± 0.2
83.05	Δ^7-Stigmastenol	4.1 ± 0.1
85.93	Taraxasterol isomer 1[a]	17.0 ± 0.0
86.20	Taraxasterol isomer 2[a]	5.0 ± 0.0
	Total identified	91.4
	Total phytosterols and triterpenes in unsaponifiable fractions	20.1