Antimicrobial properties of essential oils extracted from plants of the Asteraceae family against Herpes Simplex Viruses (HSV-1, HSV-2): a systematic review

Marco **VALUSSI** [a], Didier **PESONI** [b], Pascale **FRENNET** [c], Davide **DONELLI** [d], Michele **ANTONELLI** [d]

[a] EHTPA, Norwich (United Kingdom) [b] OT Formations, Les Avirons (France) [c] Des Arômes et des Sens, Namur (Belgium) [d] AUSL-IRCCS, Reggio Emilia (Italy)

INTRODUCTION

Asteraceae, also called *Compositae,* are a broad family of flowering plants, mostly of herbaceous appearance, sometimes used for the production of different essential oils.

AIM

To study the antimicrobial properties of essential oils extracted from plants of the *Asteraceae* family against Herpes Simplex Viruses 1 and 2.

METHODS

Databases: ISI Web of Science, PubMed, EMBASE, Scopus, Google Scholar, CINAHL, Cochrane Library. Search date: May 1st, 2020.

Guidelines: the National Toxicology Program's "Handbook for Conducting Systematic Reviews for Health Effects Evaluations".

RESULTS

After database search, 11 laboratory studies were included in this review (Table 1).

The antiviral activity of analyzed oils was mostly attributed to a direct inactivation of free virions and to the inhibition of viral penetration into host cells. Nevertheless, intracellular mechanisms of action were not fully excluded, especially for *Santolina insularis*.

TABLE 1. Summary of results.

Reference	Cell lines	Essential oil plant	Virus	Negative control	Positive control	Results	D-R	Antiviral efficacy
C. Sinico et al. 2005	Vero cells	*Artemisia arborescens*	HSV-1 strain F	Yes	NR	EC50 (lip. P90H MLV)=18.5 µg/ml EC50 (lip. P90 MLV)=43.6 µg/ml	Yes	Yes, antiviral effects (detected at concentrations of 2 µg/ml) were observed prior to penetrtion of HSV-1 into host cells.
M. Saddi et al. 2007	Vero cells	*Artemisia arborescens*	HSV-1 strain F HSV-2 strain G	Yes	NR	HSV-1: IC50=1.14-6.9 µg/ml; **SI=55.0** HSV-2: IC50=4.1 µg/ml; **SI=32.2**	Yes	Yes, effective in inactivating virions of HSV-1 and HSV-2 and in inhibiting the cell-to-cell virus diffusion.
C.C. García et al. 2003	Vero cells	*Artemisia douglasiana*	HSV-1	Yes	NR	VC50=83 ppm; SI=3.8	NR	Yes, effective in inhibiting HSV-1.
S. Gavanji et al. 2015	Vero cells	*Artemisia kermanensis*	HSV-1	Yes	Acyclovir	IC50=0.004%; **SI=66.37**	Yes	Yes, effective in inhibiting HSV-1.
A.B. Sassi et al. 2008	Vero cells	*Chrysanthemum trifurcatum*	HSV-1	Yes	Acyclovir	CC50=735.9 µg/ml	NR	No, not effective against HSV-1.
C.C. García et al. 2010	Vero cells	*Eupatorium arnottianum* *Eupatorium catarium*	HSV-1 strain F	Yes	No	*E. arnottianum* IC50=52.1±2.9 ppm *E. catarium* IC50=47.9±3.2 ppm	NR	Yes, both oils were effective in inhibiting HSV-1.
C. Koch et al. 2008a	RC-37 cells Vero cells MCDK cells	*Matricaria recutita*	HSV-1 strains KOS and ANG	Yes	No	IC50=0.3±0.045 µg/ml; **SI=100**	Yes	Yes, antiviral effects were observed prior to penetration of HSV-1 into host cells.
C. Koch et al. 2008b	RC-37 cells	*Matricaria recutita*	HSV-2 strain HG52	Yes	Acyclovir	IC50= 0.00015%; **SI=20**	Yes	Yes, antiviral effects were observed prior to penetration of HSV-2 into host cells.
J. Sharifi-Rad et al. 2017	Vero cells	*Pulicaria vulgaris*	HSV-1 strain KOS	Yes	Acyclovir	IC50=0.001%; SI=1	Yes	Yes, antiviral effects were mainly observed prior to penetration of HSV-1 into host cells.
D. Valenti et al. 2001	Vero cells	*Santolina insularis*	HSV-1 strain F	Yes	NR	IC50 (lip. SUV)=2.2 µg/ml IC50 (lip. MLV)=4.6 µg/ml IC50 (free oil)=0.88 µg/ml	Yes	Yes, antiviral effects were mostly observed prior to penetration of HSV-1 into host cells (with a possible involvement of intracellular mechanisms).
A. De Logu et al. 2000	Vero cells	*Santolina insularis*	HSV-1 strain F HSV-2 strain G	Yes	NR	HSV-1: IC50=0.88 µg/ml; **SI=127** HSV-2: IC50=0.7 µg/ml; **SI=160**	Yes	Yes, effective in inactivating virions of HSV-1 and HSV-2 and in inhibiting the cell-to-cell virus diffusion.

Legends: CC50=Cytotoxicity Concentration 50%; D-R=Dose-Response effect; EC50=Half Maximal Effective Concentration; HSV-1=Herpes Simplex Virus type 1; HSV-2=Herpes Simplex Virus type 2; IC50=Inhibitory Concentration 50%; Lip.=Liposomal formulation; NR=Not Reported; SI=Selectivity Index; VC50=Virucidal Concentration 50%.

CONCLUSIONS

Essential oils extracted from different plants of the *Asteraceae* family exhibit a significant antimicrobial activity against HSV-1 and HSV-2. In particular, the majority of retrieved evidence, based on in vitro studies, supports the efficacy of *Artemisia* spp., *Matricaria recutita* and *Santolina insularis*.

Further studies are necessary to potentially translate these findings into clinical recommendations.

BIBLIOGRAPHY

A.B. Sassi et al. 2008 DOI: 10.1080/14786410701589790
A. De Logu et al. 2000 DOI: 10.1016/s0166-3542(00)00127-3
C.C. García et al. 2003 DOI: 10.1002/ptr.1305
C.C. García et al. 2010 DOI: 10.1177/1934578X1000500834
C. Sinico et al. 2005 DOI: 10.1016/j.ejpb.2004.06.005
C. Koch et al. 2008a DOI: 10.1211/jpp/60.11.0017
C. Koch et al. 2008b DOI: 10.1016/j.phymed.2007.09.003
D. Valenti et al. 2001 DOI: 10.1081/LPR-100103171
J. Sharifi-Rad et al. 2017 DOI: 10.14715/cmb/2017.63.8.10
M. Saddi et al. 2007 DOI: 10.1186/1476-0711-6-10
S. Gavanji et al. 2015 DOI: 10.1016/j.jacme.2015.07.001