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Full Length Research Paper

Antiviral activity of *Aloe vera* against herpes simplex virus type 2: An *in vitro* study

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In this study we tested the antiviral activity of a crude hot glycerine extract of *Aloe vera* gel which was grown in Bushehr (Southwest of Iran) against HSV-2 replication in Vero cell line. The extract showed antiviral activity against HSV- 2 not only before attachment and entry of virus to the Vero cells but also on post attachment stages of virus replication. The IC_{50} before attachment and entry of virus to the cells is 428 µg/ml and the CC_{50} value which is the cytotoxicity of the extract for Vero cells is 3238 µg/ml, while the calculated selectivity index (SI) is 7.56. Also, IC_{50} of extract on post attachment stages of replication is 536 µg/ml and the SI value for inhibition of the post attachment stages of HSV-2 replication is 6.04. Therefore, compounds of *Aloe vera* from Bushehr could be a good candidate as a natural source for antiviral drug development against HSV-2.

Key words: *Aloe vera*, antiviral, HSV-2, hot glycerine extract.

INTRODUCTION

People have been using herbal medicines to cure infectious disease from ancient times. In many studies for finding novel antiviral agents, some plants and algae extracts were tested on different viruses including the herpes viruses (Yoosook et al., 1999; Lopez et al., 2001; Sydiskis et al., 1991). Anthraquinone-containing extracts from different plant sources such as *Aloe vera* have shown a wide variety of pharmacological activities, such as antimicrobial, anti-inflammatory and antitumor activities (Bisset, 1994).

Aloe has been used medicinally for several thousands of years in many cultures; from ancient Egypt, Greece, and Rome to China and India. The plant has many common names and is often referred to as burn plant, first-aid plant, or medicine plant. Its name is most likely derived from the Arabic word Alloeh, meaning “shining bitter substance.

Herpes simplex virus type 2 (HSV-2) is an enveloped virus which causes genital herpes and some other important complications such as encephalitis, meningitis, eye infections and cold sore. This virus can produce latent infection in the host for life and is reactivated by stimulus to cause recurrent infections and lesions (Fields, 2001). Considering the complications of this virus, some synthe-tic antiviral compounds such as acyclovir, penciclovir and vidarabine were developed for treatment of active herpe-tic infections, but they are not effective for the treatment of latent infections (Naesens and De Clercq, 2001). On the other hand the severe side effects and the develop-ment of some resistant mutants of this virus especially during long term medication with antiviral drugs were reported (Malvy et al., 2005; Pottage et al., 1995). Also, regarding the increasing prevalence of genital herpes, there is an urgent need to develop new anti-HSV-2 drugs. Because of the reasons mentioned above, finding new natural anti herpetic compound(s) is very interesting especially from some medicinal plants such as *A. vera*. One of the anthraquinones is emodin which has been reported to have antiviral activities to some kind of viruses, such as human cytomegalovirus, herpes simplex virus type 1 and poliovirus (Bernard et al., 1992; Cohen et al., 1996; Semple et al., 2001). It is obvious that the effect of the soil composition, climate and other environ-mental factors could affect the chemical and biological composition of *A. vera* in different area.

To the best of our knowledge, no research was done to evaluate the antiviral activity of *A. vera* which were grown

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in the south west of Iran. Here, we have attempted to evaluate the anti HSV-2 activity of this plant from Bushehr port in the south west of Iran.

MATERIALS AND METHODS

Preparation of *Aloe vera* extract

A. vera was collected from the pilot farm of the Jahad Keshavarzi Research Centre Bushehr (South west of Iran). The Aloe leaf was cut and the fresh gel within the leaf was extracted. The extracted gel corresponding to was dissolved in 10% glycerine solution. The mixture was boiled for 20 min in 105 ºC. The hot glycerine extract was clarified by filtration using Whatman No.1 filter paper. It was, thereafter, sterilized by autoclaving.

Cell line and virus

Vero cells (African green monkey kidney cell line) were used for HSV-2 replication and propagation. Briefly, the cells were grown in 50 ml cell culture flasks (NUNC) or 24 wells cell culture microplates (NUNC) by using Dulbeccos Minimum Essential Medium (Gibco) containing 10% foetal bovine serum (Gibco). Herpes simplex virus type 2 was isolated from clinical sample and confirmed by using anti HSV- 2 type specific flourescent monoclonal antibody (DAKO). The virus was propagated in Vero cells and the titre of propagated viral stock was determined as $TCID_{50}$/ml by using Karber method. The viral stock after titration was dispensed in some sterile tubes which were stored at -70ºC.

Cytotoxicity test

The cytotoxicity of alga extract was determined by culturing of Vero cells for 72 h in the presence of increasing amounts of extract. Then viable cells were determined by the trypan blue exclusion test. The results were plotted at dose response curve, and by using STATA statistical software the 50% cell growth inhibitory concen-tration (CC_{50}) was obtained.

Antivirial activity assay

In this study we used the cytopathic effect inhibition assay for evaluation of antiviral activity of the aloe extract. To begin with, Vero cells were grown in 24-well plastic plates ($7*10^3$ cells /well). Then the plates were incubated at 37ºC in the presence of 5% CO_2 until the cells became confluent. Thereafter, the culture medium was removed from each well. 0.1 ml of virus suspension containing 10000 $TCID_{50}$ and 0.1 ml of DMEM containing 2% FBS were mixed in each well of 24-well plates and appropriate concentrations of the extract from minimal to maximal non-cytotoxic concentration were added to each well based on serial dilution preparation.

For the virus control 0.1 ml of virus suspension and 0.1 ml of culture medium without extract were used. For the cell control 0.1 ml of culture medium with maximal non cytotoxic concentration of extract were added. Also for evaluation of probable antiviral effect of 10% glycerine solution 0.1 ml of virus suspension and 0.1 ml of sterile 10% glycerine solution without extract were used. The plates were incubated at 37ºC in a humidified CO2 atmosphere (5%, CO2) and were investigated everyday for CPE presentation until 5 day post infection. For testing the probable post attachment antiviral effect of the extract, same protocol which mentioned above was done but the adding of the extract was two hours post inoculation of cells with virus. The degree of inhibition was expressed as percent yield of virus control (% virus control = CPE experimental group/ CPE virus control *100) . The concentration of extract which reduced CPE 50% with respect to virus control was estimated from graphic plots defined as 50% inhibited concentration (IC_{50}) expressed in microgram per milliliter by using STATA modeling software. The selectivity index (SI) was measured from the ratio of CC_{50}/IC_{50} (Kudi and Myrint, 1999; Kujumgier et al., 1999).

Statistical analysis

STATA statistical analysis package was used for the dose response curve drawing in order to IC_{50} and CC_{50} calculation.

RESULTS

The cytotoxicity of Aloe vera gel crude extract on Vero cells was determined by calculation of CC_{50} which is 3238 µg/ml. Meanwhile, the 1000 µg/ml of hot glycerine extract of *A. vera* gel showed the cytotoxicity just for 10% of Vero cells, 5500 µg/ml of the extract was cytotoxic for 100% of treated cells.

Treatment of the Vero cells with different concentrations of crude extract at the same time of inoculation by HSV-2 was done based on the method mentioned in materials and methods section. Based on results, we understood that 100 µg/ml of the extract did not show any antiviral effect while the 700 µg/ml of that extract could inhibit the performing of cytopathic effect comple-tely due to HSV-2 replication in Vero cells. Therefore the IC_{50} of this extract by using STATA modelling software is 428 µg/ml (Figure 1). From the resulting IC_{50} and CC_{50} from extract, the SI value is 7.56 for *A. vera* gel hot glycerine extract.

The antiviral activity of the crude extracts was tested on post attachment stages of the virus replication cycle. It was observed that 100 µg/ml of the extract could not prevent the performing of cytopathic effect of HSV-2 in cell culture and 850 µg/ml of that extract inhibited the HSV-2 related CPE performing in Vero cells completely. Therefore the IC_{50} value for filtered extract is 536 µg/ml, while the SI value for the antiviral activity is 6.04 (Figure 2).

DISCUSSION

A. vera is a member of the Liliaceae. Topical aloe has been used for wounds such as cuts and burns owing to its perceived effectiveness in improving healing (Perfect et al., 2005). The aloe plant is the source of two herbal preparations; aloe gel and aloe latex. Aloe gel is often refers to the clear gel or mucilaginous substance produced by parenchymal cells located in the central region of the leaf. Diluted aloe gel is commonly referred to as "*A. vera* extract". The gel is composed mainly of water (99%) and mono- and polysaccharides (25% of the dry weight of the gel). The most prominent monosaccharide in AG is mannose-6-phosphate, and the most common polysac-

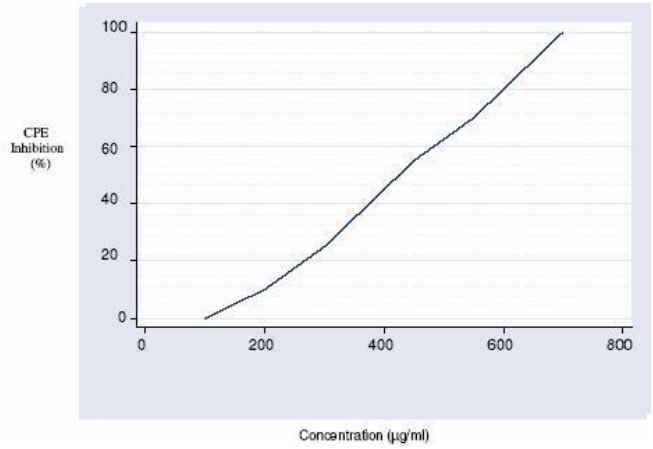

Figure 1. Dose response curve of *Aloe vera* extract against HSV-2 (at the same time of virus inoculation).

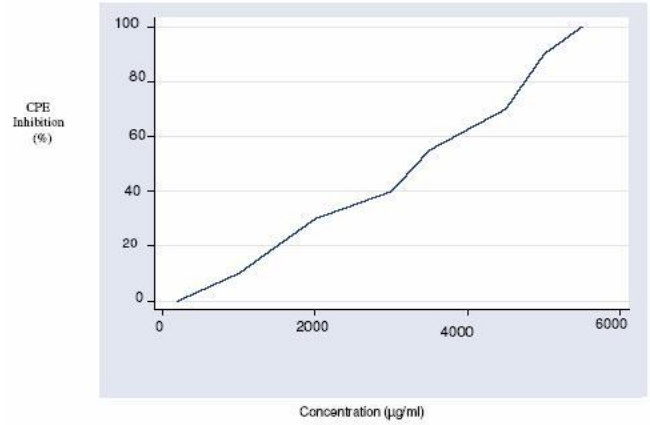

Figure 2. Dose response curve of *Aloe vera* extract against HSV-2 (after virus attachment).

charides are called gluco-mannans (Shelton, 1991). Also, there are some publications about antiviral properties of different kinds of plant extracts such as *A. vera* especially investigation about the antiviral activity of its anthraquinones (Sydiskis, 1991; Andersen et al., 1991). Interest in employing antiviral compounds from natural sources like plants or algae has been enhanced by researchers and also consumers' preference for natural medicines and concerns about the toxic effects of synthetic antiviral materials. In the present study, we chose HSV-2 for our research because of its ability for performing the different clinical complications and its increasing prevalence in communities (Rosen, 2006). This is the first study about the anti HSV-2 activity of hot glycerine extract of *A. vera* which were grown in Bushehr (South west of Iran). We have prepared hot glycerine extract of *A. vera*, because the glycerine extract is enriched for anthraquinones present in plants (Sydiskis, 1991). It is obvious that the resulting IC_{50} and CC_{50} values are not comparable with their counterpart studies in which the purified effective components such as emodin or another anthraquinones were tested.

For the sterilization of the extract, autoclaving was used, and we found that the autoclaved extract showed the acceptable IC_{50}. Based on SI values of this extract, it could be a good choice for anti- HSV-2 natural compound, although in most studies the filtering method was used for extract sterilization. Therefore the *A. vera* hot glycerine extract could be a good choice for preventing of virus adsorption, attachment or entry to the host cell. A previous study has established that aloe emodin could disrupt the envelope of viruses (Sydiskis, 1991). Results of the cytotoxicity test indicate that 5500 µg/ml of the extract was cytotoxic for 100% of Vero cells. Meanwhile other workers reported that aloe emodin of *Aloe barbadensis* did not show remarkable cytotoxic effect (Sydiskis, 1991). This difference could be due to the type of extract and/or the species of plant or some unknown factors. In other studies, stimulation of immune system against some viral complications due to Aloe extract were established (Gauntt et al., 2000; Iljazovic, 2006) . Therefore, an *in vivo* study on the antiviral activity or another aspect of medical applications of the *A. vera* of Bushehr is recommended. Also, further investigation on the antiviral activity of this plant on naked viruses could be interesting. It is obvious that for future works, identification of the effective compounds of the extract and the quantitation of these elements are necessary.

REFERENCES

Andersen DO, Weber ND, Wood SG, Hughes BG, Murray BK, North JA (1991). In vitro virucidal activity of selected anthraquinones and anthraquinone derivatives. Antiviral. Res.16: 185-196.

Bernard DL, Huffman JH, Morris JL, Wood SG, Hughes BG, Sidwell RW (1992). Evaluation of the antiviral activity of anthraquinones, anthrones and anthraquinone derivatives against human cytomegalovirus. Antiviral. Res. 35: 2463-2466.

Bisset NG (1994). Herbal drug and phytopharmaceutical. Boca Raton, CRC Press. Cohen PA, Hudson JB, Towers GH (1996). Antiviral activities of anthraquinones, bianthrones and hypericin derivatives from lichens. Experientia. 52: 180-183.

Fields BN (2001). Fields virology. Lippincott Raven Publisher, U. S. A.

Gauntt CJ, Wood HJ, Mc Daniel HR, Mc Analley BH (2000). Aloe polymannose enhances anti-coxsackievirus antibody titres in mice. Phytother. Res. 14: 261-266.

Iljazovic ED, Ljuca A Sahimpasic, Avdic S (2006). Efficacy in treatment of cervical HRHPV infection by combination of beta interferon, and herbal therapy in woman with different cervical lesions. Bosn. J. Basic. Med. Sci. 6: 79-84.

Kudi AC, Myrint SH (1999). Antiviral activities on some Nigerian medicinal plants extracts. J. Ethnopharmacol. 68: 289-294.

Kujumgier A, Tsevtkova I, Serkedjieva J, Bankova V, Christov R, Popov S (1999). Antibacterial, antifungal and antiviral activity of propolis of different geographic regions. J. Ethnopharmacol. 64: 235-240.

Lopez A, Hudsonb JB, Towers GHN (2001). Antiviral and antimicrobial activities of Colombian medicinal plants. J. Ethnopharmacol. 77: 189-196.

Malvy D, Treilhaud M, Bouee S, Crochard A, Vallee D, El Hasnaoui A, Aymard M (2005). A retrospective case control study of acyclovir resistance in herpes simplex virus. Clin. Infect. Dis. 41: 320-326.

Naesens L, De Clercq E (2001). Recent developments in herpesvirus therapy. Herpes. 8: 12-16.

Perfect MM, Bourne N, Ebel C, Rosenthal SL (2005). Use of complementary and alternative medicine for the treatment of genital herpes. Herpes. 12: 38-41.
Pottage JC, Kessler HA (1995). Herpes simplex virus resistance to acyclovir clinical relevance. Infec. Agent. Dis. 4: 115-124.
Rosen T (2006). Sexually transmitted diseases: a dermatologist's view. Cleveland. Clin. J. Med. 73: 537-538.
Semple SJ, Pyke SM, Reynolds GD, Flower RL (2001). In vitro antiviral activity of the anthraquinone chrysophanic acid against poliovirus. Antiviral. Res. 49: 169-178.
Shelton M (1991). *Aloe vera*, its chemical and therapeutic properties. Int. J. Dermatol. 30: 679-683.
Sydiskis RJ, Owen DG, Lohr JL, Rosler KH, Blomster RN (1991). Inactivation of enveloped viruses by anthraquinones extracted from plants. Antimicrob. Agents. Chemother. 35: 2463-2466.
Yoosook C, Panpisutchaia AY, Chaichanab S, Santisukc T, Reutrakulb V (1999). Evaluation of anti – HSV- 2 activities of Barleria lupulina and Clinacanthus nutans. J. Ethnopharmacol. 67: 179-187.