Quality and Potency Analysis of *IVY* Leaf Extract

Sidra Yasmeen\(^5\), Rafia Usman\(^1\), Sultan Ayaz\(^2\), Fatima Qamar\(^5\), Syeda Zainab\(^5\), Halima Sadia\(^5\), Hira Munir\(^3\), Amaris Arif\(^5\), Sadia Shakeel\(^4\), Aqib Zahoo\(^3\), Kashifa Khanum\(^3\), Zubair Uddin Faridi\(^5\)

\(^1\)NED University of Engineering and Technology Karachi, Pakistan
\(^2\)Department of Eastern Medicine, GC University, Faisalabad, Pakistan
\(^3\)Research & Development, Herbion Pakistan (Pvt) Limited, Karachi.
\(^4\)Faculty of Pharmaceutical Sciences, Dow University of Health Sciences, Karachi
\(^5\)Faculty of Pharmacy, Jinnah University for women, Karachi, Pakistan

**ABSTRACT**

**Background:** *Hedera helix* generally recognized as Ivy or English *Ivy* and has been employed since a long time in conventional medication in management of respiratory problems.

**Objective of the study:** The current study was conducted with the aim to evaluate *Ivy* leaf extract to authenticate the quality of extract.

**Methods:** Evaluation was conducted on different physicochemical factors of extract that include physical appearance, organoleptic properties and solubility. Loss on drying, microbial analysis and heavy metal analysis was also carried out to execute the safety of extract. High performance liquid chromatography was executed to evaluate the presence of Hederacoside C in *Ivy* leaf extract employing phosphoric acid 85 %, acetonitrile, water (2:140:860 v/v/v) as a mobile phase.

**Results:** Extract exhibited greenish brown color, distinctive odor and sweet taste. An *Ivy* extract was found in agreement of the allowable microbial limit as well as with the heavy metal contents limit. The presence of Hederacoside C in *Ivy* leaf extract was confirmed by HPLC.

**Conclusion:** The current evaluation reveals conformity with all the analytical procedures. Hence *Ivy* leaf extract is well standardized formulation at the base line consideration.

**Keywords:** Analysis; Evaluation; *Ivy* leaf extract; Hederacoside C

**INTRODUCTION**

*Hedera helix* L. belongs to a family *Araliaceae* and generally recognized as Ivy or English *Ivy*. The young leaves extract of the plant has been employed since a long time in conventional medication in management of respiratory problems owed to its broncho spasmolytic and expectorant effects [1]. At present a variety of pharmaceutical formulations of *Ivy* leaf extract including solid, liquid and semisolid dosage forms are accessible for public to cure the ailments [2,3]. There are several clinical trials conducted using *Ivy* leaves that have verified the effectiveness and quality of such drugs. Due to the investigational and pragmatic proof on its efficiency and safe use, a noteworthy augmentation of its prescribing practices has been observed in several European countries includes Germany [4]. Mass percentage i.e. greater than 80% of plant based expectorants recommended in Germany In 2007, consisted of *Ivy* leaf extract and accounted to almost two million prescriptions countrywide.
There is a vast variety of chemical constituents that have been isolated from *H. helix*, including polyacetylenes, triterpene, flavonoids, saponins and various phenolic compounds [5]. A triterpene saponin α-hederin, is known to be accountable for the beneficial consequences of *Ivy* leaf extract since it possess β2-adrenergic properties [6]. Hederacoside C, an important triterpene saponin, is recognized to be metabolized in the active form and generate the consequences of α-hederin in the body [6,7]. The current investigation was conducted with the plan to evaluate the quality and potency of *Ivy* leaf extract.

**Experimental**

**Extract preparation**

All the herbal drugs to be utilized in the research were sieved by using mesh #60 and grinded. Every herb was put in extractor; water was used as a solvent in the proportion of 1:10 with herbs. Then finally the decoction was obtained and filtered.

**Organoleptic evaluation**

*Ivy* leaf extract was evaluated for its organoleptic properties including color, odour and taste.

**Loss on drying**

Before testing, Petri dish was kept in the oven at 105°C for 30 minutes and cool the Petri dish by using desiccator and weigh it, the weight was noted as W1. After accurately weighing transfer about 1.0g of sample into Petri dish and note down the weight as W2. Petri dish was placed with sample into the oven at 105°C for approx 1.5hr. After drying the Petri dish was removed and kept into desiccator. After cooling, the Petri dish was weighed with sample and note down the weigh as W3.

**Calculation**

\[
\text{% of loss on drying} = \frac{(W2 - W3) \times 100}{W2 - W1}
\]

Where,

W1 = Weight (g) of the empty weigh bottle

W2 = Weight (g) of the weigh bottle with sample before drying.

W3 = Weight (g) of the weigh bottle with sample after drying.

**Assay using High Performance Liquid Chromatography**

**Sample preparation**

In 10 volumetric flask, 100 mg of extract was dissolved and diluted using methanol to make up to mark with the same solvent. The solution was then pass through the process of sonification for 30 minutes using ultra sonic bath and filtered by means of a filter having a pore size of 0.45 μm, proceed for HPLC analysis.

**Standard solution preparation**

In a 10 ml volumetric flask, 10 mg of Hederacoside C standard was taken and dissolved using methanol; make up the volume with methanol. The solution was sonicated in the ultra sonic bath. Filter the obtained solution by means of a filter having a pore size of 0.45 μm and use filtrate for chromatography.

**Analysis**

20 μL of sample and Hederacoside C standard solutions were injected and 3 chromatograms in the subsequent conditions were obtained:

Injection sequence was Diluent (blank): 01 followed by Standard: 05 Sample: 02 and Bracket standard: 01. System suitability was RSD NMT 2.0% (5 replicate injections). Column: Size: L = 250 mm, Ø = 4.6 mm at 40 ºC column temperature. Stationary phase: Octadecylsilyl silica gel (5 μm). Mobile phase were phosphoric acid 85 %, Acetonitrile, water (2:140:660 v/v/v) (Phase A) and phosphoric acid 85 %, Acetonitrile (2:998 v/v) (Phase B) respectively with 1.5 ml/min of flow rate at a wavelength of 205 nm.

**Gradient system**

| Time (min) | Mobile Phase A (% v/v) | Mobile Phase B (%v/v) |
|------------|------------------------|-----------------------|
| 0          | 100                    | 0                     |
| 40         | 60                     | 40                    |
| 41         | 0                      | 100                   |
| 55         | 0                      | 100                   |
| 56         | 100                    | 0                     |
| 70         | 100                    | 0                     |
Formula:

$$% \text{ of Hederacoside C} = \frac{A_{\text{SPL}} \times W_{\text{STD}} \times \text{dilution of spl} \times P}{A_{\text{STD}} \times \text{dilution of std} \times W_{\text{SPL}} \times 100} \times 100$$

Where,

$A_{\text{SPL}}$ – Average Area of sample

$A_{\text{STD}}$ – average area of standard

$W_{\text{SPL}}$ – Sample weight, mg

$W_{\text{STD}}$ – Standard weight, mg

$P$ – Percent Purity of standard sample, %

Note: Quantity of Hederacoside C contents in *Ivy* leaf extract should NLT 3.0%

**Microbial contamination:**

Microbiological Examination of *Ivy* leaf extract was carried out as per the of herbal medicinal products for oral use [8].

**Determination of heavy metal contents:**

Evaluation of trace elements was carried out by atomic absorption spectrometry flame (FAAS) at the Pakistan Council of Scientific and Industrial Research (PCSIR) Laboratory at Karachi, Pakistan.

**RESULTS**

*Ivy* leaf extract exhibited greenish brown color, typical odor and sweet taste. A vital practice of flavor masking is executed to remove repulsive drugs from getting contact with the taste buds [9]. (Table 1).

Determination of physicochemical properties plays a significant part in the quality measurement [10].

### Table 1. Organoleptic evaluation of *Ivy* leaf extract.

| Items            | Specification                  | Test Results  |
|------------------|--------------------------------|---------------|
| **Physical & Chemical Data** |                                |               |
| Appearance       | Fine Powder                    | Complies      |
| Color            | Greenish brown powder          | Complies      |
| Odour            | Characteristic                 | Complies      |
| Solubility       | Soluble in hydro, Hydro –alcoholic solutions | Complies      |

**Table 2. Specifications of *Ivy* leaf extract.**

| S.NO | TEST                      | SPECIFICATIONS                      |
|------|---------------------------|-------------------------------------|
| 01   | Appearance                | Greenish brown powder.              |
| 02   | Identification            | The retention time for the major peak in chromatogram of the Assay preparation match to that of the Standard preparation. |
| 03   | Loss on drying            | NMT 5.0 %                           |
| 04   | Assay (Hederacoside C)    | NLT 10.0%                           |

**Figure 1.** Structure of Hederacoside C found in *Ivy* leaf extract.

**Figure 2.** Chromatogram of Hederacoside C.
Table 3. Acceptable contents for 1g of preparation.

| Microbial Analysis        | Limit CFU/g          | Observation |
|---------------------------|----------------------|-------------|
| Aerobic viable count up   | NMT 10⁴ CFU/g        | conform     |
| Salmonella                | not present          | not present |
| *E. coli*                 | not present          | not present |
| *S. aureus*               | not present          | not present |
| *P. aeruginosa*           | not present          | not present |
| *Entire fungal count*     | NMT 10² CFU/g        | conform     |

Figure 1 represents the structure of Hederacoside C. Loss on drying and assay results are given in Table 2. Figure 2 represents the structure of Hederacoside C. Massive bacteria may be frequently viewed in soil or derived fertilizers [11,12]. Hence there is enhanced probability for the occurrence of microbial pollution in plant based drugs. An *ivy* extract was found concord of the permissible microbial confines. Table 3 Plant based drugs are typically accessible as a blend of more than one plant component and its medicinal action relies on its phytochemical components [13]. Precise recognition and quality assurance is an essential prerequisite to make certain reproducible quality of such drugs [14]. Phytochemical evaluation indicates the quality dimension; include preliminary phytochemical analysis, chemoprofiling, and biomarker examination using novel analytical methods. HPLC is a considerable means for the quantitative phytochemical scrutiny of the plant based drugs. In current study Hederacoside C an active biomarker of *ivy* leaf was detected and the peak of Hederacoside C complies with standard.

**DISCUSSION**

The toxic effects of trace metals on human welfare and the atmosphere have fascinated major contemplation in recent years. The heavy metal contents have small excretion rates that may result in unfavorable consequences on human being still at very low amount. Metals for instance copper, manganese, zinc, iron, and chromium are basic nutrients; required for the basic physiological and natural functions of the human being. On the other hand, an increase in their ingestion over definite acceptable confines can turned out to be noxious. There are numerals of healthiness issues linked to excessive uptake of dietary heavy metals [15]. The elements that have been revealed to be noxious are precisely Arsenic (As), mercury (Hg), Cadmium (Cd) and lead (Pb). The concentration of As, Cd, Pb and Hg were examined in *ivy* leaf extract and they were not detected in extract (Table 4).

Table 4. Heavy metal analysis of extract.

| Plant                     | Specifications     | Heavy Metals |
|---------------------------|--------------------|--------------|
| *Hedera helix* L.         | Arsenic (NMT 10 ppm) | Not found |
|                           | Cadmium (NMT 0.3 ppm) | Not found |
|                           | Lead (NMT 10 ppm)   | Not found   |
|                           | Mercury (NMT 1 ppm) | Not found   |

**CONCLUSIONS**

The current evaluation reveals conformity with all the analytical procedures. The evaluation provides precise and accurate means to develop qualifications for identity, precision and reproducibility of biomarkers in *ivy* leaf extract. Hence the extract is well standardized formulation at the base line consideration.

**REFERENCES**

1. Yu M, Shin YJ, Kim N, Yoo G, Park S, Kim SH. Determination of saponins and flavonoids in *ivy* leaf extracts using HPLC-DAD. J. Chromatogr. Sci. 2015;53(4):478-83. https://doi.org/10.1093/chromsci/bmu068
2. Cwientzek U, Ottillinger B, Arenberger P. Acute bronchitis therapy with *ivy* leaves extracts in a two-arm study. A double-blind, randomised study vs. an other *ivy* leaves extract. Phytomedicine. 2018;18(13):1105-9. https://doi.org/10.1016/j.phymed.2011.06.014
3. Holzinger F, Chenot JF. Systematic review of clinical trials assessing the effectiveness of *ivy* leaf (*hedera helix*) for acute upper respiratory tract infections. Evidence-Based Complementary and Alternative Medicine. 2010;2011. https://doi.org/10.1155/2011/382789
4. Büechi S, Vögelin R, von Eiff MM, Ramos M, Melzer J. Open trial to assess aspects of safety
Quality and Potency Analysis of IVY Leaf Extract

and efficacy of a combined herbal cough syrup with ivy and thyme. Complement Med Res. 2005;12:328-332. https://doi.org/10.1159/000088934

5. Viougeas MA, Rohr R, Chamal A. Structural changes and permeability of ivy (Hedera helix L.) leaf cuticles in relation to leaf development and after selective chemical treatments. New Phytol. 1995;130(3):337-48. https://doi.org/10.1111/j.1469-8137.1995.tb01828.x

6. Sieben A, Prenner L, Sorkalla T, Wolf A, Jakobs D, Runkel F, Häberlein H. α-Hederin, but not hederacoside C and hederagenin from Hedera helix, affects the binding behavior, dynamics, and regulation of β2-adrenergic receptors. Biochem. 2009;48(15):3477-82. https://doi.org/10.1021/bi802036b

7. Wolf A, Gosens R, Meurs H, Häberlein H. Pre-treatment with α-hederin increases β-adrenoceptor mediated relaxation of airway smooth muscle. Phytomedicine. 2011;18(2-3):214-8. https://doi.org/10.1016/j.phymed.2010.05.010

8. Bedir E, Kirmizipekmaz H, Sticher O, Çalış İ. Triterpene saponins from the fruits of Hedera helix. Phytochemistry. 2000;53(8):905-9. https://doi.org/10.1016/S0031-9422(99)00503-8

9. Avbunudigha JA, Alalar CA, Builders PF, Odozie S. Development and evaluation of liquid oral phytoformulation of Phyllanthus amarus. J Pharm Res. 2013;6(9):908-12. https://doi.org/10.1016/j.jopr.2013.08.029

10. Modi J, Soni H, Pandya K, Patel G, Patel N. A detail phyto-chemical evaluation of herbo-mineral formulation used in respiratory diseases. J Pharmacogn Phytochemistry. 2014;2(5):36-42.

11. Siddiqui S, Usmanghani K, Zahoor A, Sheikh ZA, Khan SS. Quantitative Estimation of Gallic Acid as Biomarker in Lipitame Tablets by HPTLC Densitometry for Diabetic Dyslipidemia. CHIN MED. 2014 Dec 10;5(04):170.

12. Sojitra J, Dave P, Pandya K, Parikh V, Patel P, Patel G. Standardization study of poly herbal formulation-caspa drops. Int J Pharm Sci Drug Res. 2013;5(3):113-9.

13. Kumar V, Malhotra N, Pal T, Chauhan RS. Molecular dissection of pathway components unravel atisine biosynthesis in a non-toxic Aconitum species, A. heterophyllum Wall. 3 Biotech. 2016 1;6(1):106.

14. Rol N, Enow E, Bechem E. Tree seedlings ecology in the undisturbed and disturbed Takamanda Rainforest of south west region, Cameroon. E. Int. J. Adv. Res. Biol. Sci, 2014;1(9), 117-134.

15. Rao A. Trace element estimation–Methods & clinical context. Online J Health All Sci. 2005;4(1).

This is an Open Access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.