

Pharmaceutical Evaluation of *Physalis peruviana* from Far Western Nepal

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Abstract:- This study provides valuable information regarding phytochemical screening and antimicrobial activities of ripen fruits of *Physalis peruviana* from darchula district of Far Western region of Nepal. *Physalis peruviana* fruits contain many pharmaceutically important secondary metabolites such as withaphysalins, physalins, phytosterols, polyphenols, flavonoids, proteins, aminoacids, saponins, tannins, terpenoids, vitamins, carbohydrates, carotenoids, vitamin C, vitamin E, essential fatty acids and minerals which are responsible for wide range of antibacterial effects. The fruits are rich in ash, fibres and moisture content.

The crude extract of the *Physalis peruviana* fruits was analysed by GC-MS as compared to reference database. The antimicrobial activity against gram positive and gram negative bacteria viz, *Bacillus subtilis*, *Pseudomonas syringae*, *Escherichia coli*, and *Salmonella shigella* were evaluated. The extract has shown excellent antibacterial potential by measuring zone of inhibition and minimum inhibitory concentration (MIC) along with minimum bactericidal concentration (MBC) and IC₅₀ value.

Keywords:- *Physalis Peruviana*, Phytochemicals, Secondary Metabolites, Pharmacology, Cyto-Toxicity, Antibacterial Activity, Anti-Inflammatory.

I. INTRODUCTION

Physalis peruviana belongs to the family solanaceae which consists of nearly 100 genera and 2500 species, distributed in different parts of the world. They include

many of our favourite foods with different important phytochemicals (Bazalar et.al., 2019; Dhami and Mishra, 2015). The family contains many wild growing species such as *Physalis* which is the fifth largest genus of the Solanaceae, comprising of about 70 species (Bazalar et.al., 2019). Plants belonging to Solanaceae exhibit different growth forms such as trees, shrubs, herbs, climbers, and epiphytes (Akharaiyi and Boboye, 2010). *Physalis* is an upright, herbaceous, semi-shrub, perennial species which can grow up to 1 m tall. The specific calyx becomes enlarged to surround the fruit and go downwards. Because of the inflated calyx it has been named *Physalis* in Greek which means bladder. The juicy berry fruit can reach 1.25 to 2.50 cm in diameter with many small seeds.

Recently, *Physalis* has become an important food crop and widely cultivated in tropical, subtropical and temperate regions. Several studies have mentioned the nutritional use of *Physalis* fruits in different parts of the world, including their consumption as raw, or in salads, sauces, compotes and jams (Cakir et.al., 2014). Some *Physalis* species, such as *P. peruviana* (cape gooseberry) and *P. pubescens* (husk tomato) have been cultivated and eaten for their acidulous fruits. Fruits of some of *Physalis* species are edible with numerous important therapeutic phytochemicals such as physalins, withanolides, phenolics, phytosterols, carotenoids, vitamins and minerals (WHO, 2005). It is used for liver, kidney or bladder dysfunctions and many diseases such as jaundice, hemorrhoids, and helminths diseases. Based on recent studies many pharmacological activities are attributed to this genus. Its potential antitumor, immunomodulatory, antiinflammatory, hepato-renal protection and so on is remarkable (Kasali et.al., 2021).

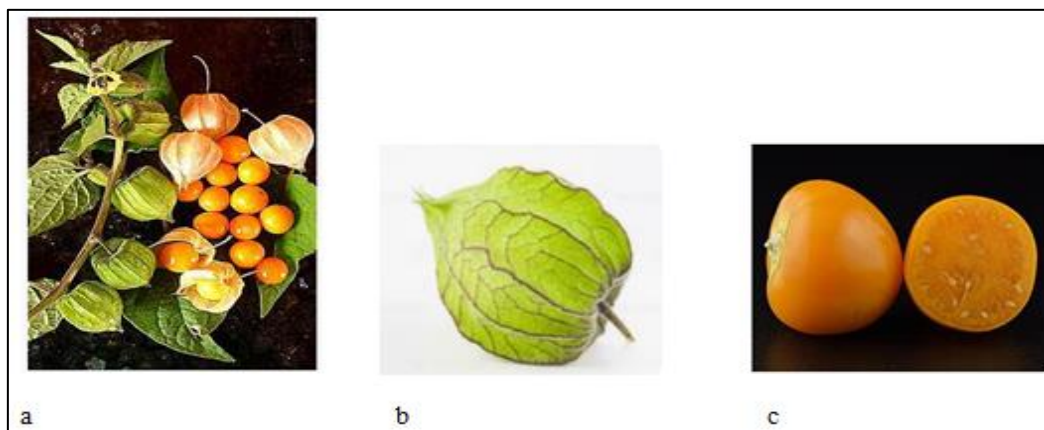


Fig 1: a. Whole Plant b. Matured Fruit c. Section of Fruit

Fruits are long-lasting, can be stored for several months and also freeze well. *Physalis peruviana* fruit has been used as a good source of provitamin A, minerals, vitamin C and vitamin B-complex. The fruit contain soluble solids (mainly sugars) and its high level of fructose makes it valuable for diabetics (Ranabhat et.al., 2022).

This plant is abundantly found in Nepal almost in all the geographical conditions which cover heterogeneous climates. Nepal is a landlocked country located in South Asia with China in the north and India in the south, east and west. The country occupies 147,516 sq. km of land. Topographically Nepal is divided into three distinct ecological regions. These are the Mountains, Hills, and Terai or plains. Soil texture, temperature, rainfall and other climatic conditions are suitable for *Physalis peruviana* growth. It occurs as wild shrubs rather than cultivation in Nepal.

II. MATERIAL METHODS

Physalis peruviana was collected from Darchula district of Far Western Nepal during November 2023. Average rain fall of this district is 177.68 mm, average maximum and minimum temperatures are 28.9 °C and 12.7 °C respectively. Average highest elevation of this district is 7132 m and lowest elevation is 518 m with longitude of 80.5394872 and latitude of 29.8424446(Central Bureau of Statistics, Govt. of Nepal, 2022).

Fruits of *Physalis peruviana* were collected, washed, weighed and air dried followed by storing in plastic bags for laboratory analysis. Some dried fruits of *Physalis peruviana* were grounded to a finely coarse powder and 10 grams of the powder was mixed with 25 ml of different solvents like water, methanol, acetone, hexane in batch wise manner. Then the content was stirred well under the mixture to get uniform slurry for 5 minutes in each case followed by centrifuging to remove the residues for about 30 minutes. The solvent was evaporated by distillation under reduced pressure. All of the fractions of the extraction were mixed to get crude oil or extract.

Ash, fats, fibres, moisture, crude protein, carbohydrate content, Na, Mg, P, K, Ca, Mn, Fe, Cu and Zn measurement,

amino acids estimation were conducted according to the AOAC (Association of Official Analytical Chemists) protocol (AOAC, 2016). Gas chromatography analysis (GC-MS) of the extract of the *Physalis peruviana* fruits was carried out using gas chromatography (Thapa et.al., 2024). The components were verified by matching their mass spectra and retention time with the standard database. The total phenolic, total flavonoids, saponins, etc of the *Physalis peruviana* fruits were evaluated according to the reported literature methods (Ranabhat et.al., 2022).

Antibacterial activity of the phytochemicals was carried out with four microorganisms including two Gram-negative bacteria (*Escherichia coli* and *Salmonella shigella*) and two Gram-positive bacteria (*Bacillus syringae* and *Bacillus subtilis*) by the disk diffusion method (Mishra, 2023). The strains were maintained on slants of nutrient agar at 4 °C in the laboratory. The microorganisms were cultured in Agar broth at 37 °C for 24 hours for measuring the zone of inhibition. Minimum inhibitory concentration (MIC), minimum bactericidal concentration (MBC) and half maximum inhibitory concentration (IC₅₀) were observed with brine shrimps (Chaudhary et.al., 2023).

III. RESULTS AND DISCUSSION

Prominent phytochemicals contained in crude extract of fruits of *physalis peruviana* obtained with water, methanol, acetone and hexane as indicated by GC-MS are Carbohydrates, Protins, Fats, Vitamins, Aminoacids, Polyphenols(GAE), Flavonoids(QE), Terpenoids, Tannins, Steroids, Saponins, Withanolides, Physalins, Carotenoids, Physalins, Carotenoids, Fibre, etc. Among the minerals Na, Mg, P, K, ca, Mn, Fe, Cu and Zn have been detected in the crude extract. Fruits contain higher amount of moisture and fibre as fresh fruits were used for the determination of concentration of different compounds and minerals. There may be the presence of some other chemicals with other solvent systems. However, the solvent system used here ranges from highly polar to nonpolar for assuring extraction of all kinds of compounds. The amount of the components was determined in 100gm of fresh fruit. The minerals and major classes of these compounds along with their antibacterial actives are mentioned in the table below:

Table 1: Phytochemical Screening and Antibacterial Activities of Crude Extract of *physalis peruviana*

SN.	Components	Abundance(gm/100gm FW)
1. Minerals	Na	1.6
	Mg	1.0
	P	6.4
	K	8.6
	Ca	7.1
	Mn	0.9
	Fe	0.8
	Cu	0.9
	Zn	0.5
	Moisture	15.6
	Ash	10.0
	Fibre	7.0

2. Chemicals	Fats	1.0
	Carbohydrates	4.5
	Protins	3.0
	Vitamins	2.0
	Aminoacids	5.0
	Polyphenols(GAE)	3.0
	Flavonoids(QE)	4.2
	Terpenoids	1.5
	Tannins	2.5
	Steroids	1.2
	Saponins	2.5
	Withanolides	2.5
	Physalins	1.2
	Carotenoids	2.5
3. Antibacterial activity	Bacterial strands	MIC/MBC Values(mg/mL)
	<i>Escherichia coli</i>	2.5/4.5
	<i>Salmonella shigella</i>	1.25/5.2
	<i>Pseudomonas syringae</i>	0.3/1.25
	<i>Bacillus subtilis</i>	2.5/5.0

Crude extract of the plant contains good amount of minerals for moderate requirement to nutritious diet. The amount of potassium, calcium and phosphorous are 8.6, 7.1 and 6.4 gm/100gm of fresh weight of fruits respectively which lie closer to reference values for the same plant. Moisture content is 15.6, ash is 10 and fibre is 7 gm/100gm of FW of the fruits. These contents cover a major fraction of phytochemicals. The fruits are good source of carbohydrates, proteins, vitamins, steroids, aminoacids, polyphenols and flavonoids. Higher amount of total phenolic content and flavonoids makes the fruits antioxidant which is an essence of healthy nutritious diet. The fruits contain excellent amount of steroids, tannins and saponins (Table 1). On the top of presence of moderate amount of minerals and chemical nutrients, the fruits of *Physalis peruviana* contain excellent antibacterial compounds. The compounds possess pleasant minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) values which prove the plant to be highly beneficial for pharmacological applications. MIC and MBC values for two gram negative bacteria *Escherichia coli* and *Salmonella shigella* ranges from 1.25 - 4.2 mg/mL. Similarly, the same observation for two gram positive bacteria *Pseudomonas syringae* and *Bacillus subtilis* ranges from 0.3 – 4.0 mg/mL (table 1). The antibacterial activity of the crude extract of *Physalis peruviana* fruits showed the effect against *Bacillus subtilis*, *Pseudomonas syringae*, *Salmonella shigella* and *Escherichia coli* with inhibition zones of 32 mm, 28 mm, 25 mm and 21mm respectively. This measurement of zone of inhibition indicated that the plant is potential antimicrobial source in herbal pharmacology. The biological activities of fruits could be attributed to the presence of polyphenols, flavonoids, terpenoids, alkaloids and saponins in considerable concentration (table 1).

IV. CONCLUSION

Physalis peruviana is proved to be valuable medicinal plant which grows in all parts of Nepal as wild shrub. This paper provides valuable information on screening of bioactive phytochemicals contained in *Physalis peruviana* from Darchula district of Far Western region of Nepal. *Physalis peruviana* fruits contain many therapeutically important secondary metabolites and minerals in moderate concentration. Main constituent of crude extract of this plant are withaphysalins, physalins, phytosterols, proteins, aminoacids, polyphenols, flavonoids, saponins, tannins, terpenoids, carbohydrates, carotenoids, vitamin C, vitamin E, and essential fatty acids and minerals of healthy nutritional values. Plant fruits possess higher amount of ash, fats, fibres and moisture. Among the minerals, Na, Mg, P, K, Ca, Mn, Fe, Cu and Zn are prominent constituents. The extract has shown excellent IC₅₀ value and antibacterial potential against gram positive and gram negative bacteria.

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REFERENCES

- [1]. Akharaiyi F.C, & Boboye, B. (2010). Antibacterial and phytochemical evaluation of three medicinal plants. *Journal of Natural Products*, 3, 27-34
- [2]. AOAC—Association of Official Analytical Chemists (2016). *Official Methods of Analysis of AOAC International*. AOAC; Gaithersburg, MD, USA.

- [3]. Bazalar Pereda, M. S., Nazareno, M. A., & Viturro, C. I. (2019). Nutritional and antioxidant properties of *Physalis peruviana* L. fruits from the Argentinean northern Andean region. *Plant Foods for Human Nutrition*, 74(1), 68-75.
- [4]. Çakir, Ö., Pekmez, M., Çepni, E., Candar, B., & Fidan, K. (2014). Evaluation of biological activities of *Physalis peruviana* ethanol extracts and expression of Bcl-2 genes in HeLa cells. *Food Science and Technology*, 34, 422-430.
- [5]. Chaudhary, P., Panth, N., Raut, B. K., Pokhrel, N., Shrestha, N., Shakya, S., ... & Parajuli, N. (2023). Biochemical, Antimicrobial, and Antioxidant activities of some wild Mushrooms from Nepal. *BIBECHANA*, 20(2), 161-174.
- [6]. Dhama, N., & Mishra, A. D. (2015). Phytochemical variation: how to resolve the quality controversies of herbal medicinal products?. *Journal of herbal medicine*, 5(2), 118-127.
- [7]. Kasali, F. M., Tuyiringire, N., Peter, E. L., Ahoegbe, L. Y., Ali, M. S., Tusiimire, J., ... & Agaba, A. G. (2021). Chemical constituents and evidence-based pharmacological properties of *Physalis peruviana* L.: An overview. *Journal of Herbmmed Pharmacology*, 11(1), 35-47.
- [8]. Mishra, A. D. (2023). An Eco-Friendly Synthesis of Some Antimicrobial Quinolines, *International Journal of Science Academic Research*, 04(11), 6531-6533.
- [9]. National Report (2022). Central Bureau of Statistics, Government of Nepal. (<https://weatherandclimate.com/nepal/mahakali/darchula>).
- [10]. Ranabhat, K., Regmi, K. P., Parajuli, S., Thapa, R., Timilsina, A. P., Katuwal, S., ... & Regmi, B. P. (2022). Evaluation of Antioxidant, Antimicrobial, and Cytotoxic Activities and Correlation with Phytoconstituents in Some Medicinal Plants of Nepal. *Journal of Chemistry*, 2022(1), 4725801.
- [11]. Thapa, B. B., Shakya, S., Shrestha, N., Yadav, R. P., Sharma, K. R., Mishra, A. D., ... & Parajuli, N. (2024). Identification of Secondary Metabolites from Actinomycetes Isolated from the Hilly Region of Nepal. *Prithvi Academic Journal*, 7, 20-40.
- [12]. World Health Organization (2005). *Vitamin and Mineral Requirements in Human Nutrition*. World Health Organization; Geneva, Switzerland.