

Therapeutic potential and biological investigation of golden seal root (*Hydrastis canadensis* L.) powder for the management of hyperuricemia

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Abstract: Elevated uric acid levels are termed uricemia. Uric acid is the end product of protein or more specifically purine metabolism. Many medicinal and naturally existing remedies are used to reduce elevated uric acid levels. Goldenseal root is an important medicinal plant used by native Americans. This study investigated the therapeutic potential of goldenseal powder against hyperuricemia. In this study, sixty females with elevated uric acid levels were enrolled and were divided into three groups; control group (G₀) and treatment group G₁ and G₂. Treatment groups were given different doses of goldenseal root powder. Serum uric acid levels were measured before and after the trial. Chemical characterization and phytochemical analysis were also performed. 23.87±1.24% moisture is present in goldenseal root powder. 12.62±0.13% ash is present in goldenseal root while 22.81±0.09% of carbohydrates were present in goldenseal root. 12.89±0.08%, 12.72±0.57%, and 15.61±0.02% of crude protein, crude fat and crude fiber are present in goldenseal root powder. Goldenseal root powder carried a significant amount of TPC and TFC depicted in fig. 1. Total phenolic content (TPC) was 514.27±0.02 ug GAE/ ml and total flavonoid content (TFC) was 334.87±0.11 ug CE/ml. Two sample t-tests showed a significant reduction in uric acid levels when goldenseal root powder was given to subjects. All data was taken significantly at p<0.05.

Keywords: Goldenseal root, *Hydrastis canadensis*, hyperuricemia, phytochemicals, flavonoids, uricemia.

INTRODUCTION

Elevated serum uric acid levels or elevated urate ion is characterized as uricemia. These elevated uric acid levels are linked with many other metabolic complications and hypertension (López-Jiménez *et al.*, 2012). Uric acid produces as a product of protein or more specifically purine metabolism. Previously, it was believed that uric acid has no physiological role. However, scientific studies and recent research have revealed the physiological participation of urate ions. Urate ion plays a role as a part of enzymes that play role in preventing the inhibition of endothelial enzymes thus preventing endothelium from oxidative stress. It also has a role in preventing damage and complication as a result of oxidative stress (Murea & Tucker, 2019). Uric acid within normal ranges plays important role in the body. However, when uric acid exceeds the normal limit, it starts accumulating in the body in crystallized form and leads to the development of gout, joint pains, permanent bone damage, heart diseases,

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and renal diseases. Studies have also reported an association between elevated uric acid levels and the development of hypertension, high blood pressure and impaired glucose metabolism (Rock *et al.*, 2013). All these factors, make the continuous monitoring of uric acid levels important and necessary (Lin *et al.*, 2000). Elevation in uric acid level is observed due to over functionality of the xanthine oxidase enzyme. Elevated uric acid upon crystallization, starts accumulating in the knee joint and ankle joints which leads to swelling and pain (Dawson & Walters, 2006). Different medicinal plants are investigated for medicinal properties. These medicinal plants are gaining popularity among people due to their being cost-effective and having fewer side effects (Jakše *et al.*, 2019). *Hydrastis canadensis* L. is a medicinal plant which is commonly known as goldenseal. It is also used as a food supplement. Native Americans use goldenseal as a coloring agent. It is used as a remedy for skin ailments, wounds, elevated uric acid levels, digestive issues, and in ointments (Bortolotti *et al.*, 2021). Goldenseal root powder has the potential to reduce

xanthine oxidase activity. Goldenseal root powder inhibits xanthin oxidase activity and stops the formation of uric acid. Uric acids levels start decreasing and ultimately it helps in management of elevated uric acid (Battelli *et al.*, 2018). This study was aimed at determining the therapeutic effect of encapsulated goldenseal root powder in the management of elevated uric acid and study also investigated the chemical composition, phytochemical analysis, and mineral analysis of goldenseal root powder to determine its quality.

MATERIALS AND METHODS

Collection of materials

Goldenseal root powder was purchased from Amazon online store under the brand name Star west Botanicals; item No. 209335-54 and it was encapsulated in different doses. Encapsulated goldenseal root powder was stored in air-tight containers.

Characterization of goldenseal root

Goldenseal root powder was subjected to various assays described as follows:

Proximate profile of goldenseal root powder

Goldenseal root powder was analyzed for the following proximate profile including moisture content, ash, carbohydrates, crude protein, crude fiber and nitrogen-free extract (NFE) according to the AOAC method (Garcia-Amezquita *et al.*, 2018).

Phytochemical analysis of goldenseal root powder

Phytochemical analysis of goldenseal root powder was investigated for the determination of total phenolic content (TPC) and total flavonoid content (TFC). The amount of TPC AND TFC were measured in ug of Gallic acid equivalent per ml and ug of Catechin equivalent per ml respectively (M'hiri *et al.*, 2015).

Determination of minerals

For the determination of minerals, a 2g sample of goldenseal root powder was taken in a 100ml volumetric flask. In this flask 10ml of hydrochloric acid (HCL) was added and 100ml volume was prepared by using distilled water. To remove the impurities volume was filtered. The mineral standard was prepared with hydrochloric acid and lanthanum concentrations. The sample was analyzed using atomic absorption spectrophotometer (Hernández *et al.*, 2005).

Investigation of therapeutic potential of goldenseal root powder for hyperuricemia patients

Selection of subjects

60 female subjects with elevated serum uric acid levels were randomly selected from the social security hospital. The age of all subjects was between 30-60 years.

Exclusion criteria

Patients taking with any other chronic health condition and patients of the obese category were selected. Male patients and patients with obesity i.e., BMI> 30 were not selected. Pregnant and lactating women were not included in the study. Subjects taking medicines to reduce uric acid levels were not included in the study.

Inclusion criteria

All female subjects went through blood biochemical analysis by checking their serum uric acid at the start of the study was included.

Study duration

The study was conducted for 8 weeks. The trial started in first week of November 2022 and it continued till the last week of December 2022.

Treatment groups and treatment plan

Sixty female subjects were divided into three groups of 20 subjects each, with the following conditions. The control group was given no treatment. Treatment group-I and treatment group II were given doses.

G₀: Group I: Control group: No treatment was given

G₁: Uricemia Treatment group I: 5mg/kg of the body weight encapsulated goldenseal powder

G₂: Uricemia Treatment group II: 10mg/kg of body weight encapsulated goldenseal powder

Collection of blood samples

At the beginning and end of the trial blood samples of participants from the antemedial cubital vein were drawn in sample collecting tubes (Lee *et al.*, 2015).

Ethical approval

Ethical approval was taken from the Institute of Biosafety Committee.

STATISTICAL ANALYSIS

Descriptive statistical analysis by comparing the means in two-sample t-tests under a Completely Randomized Design (CRD) was carried out to investigate the level of significance (p<0.05). All statistical analyses are done with IBM SPSS Statistics 20 version (Larson, 2008).

RESULTS

Proximate analysis of goldenseal root powder

The quality of raw material used is significantly influenced by the measurement of the proximate values. To evaluate the quality characteristics of goldenseal root powder, proximate determination including moisture, ash, crude fat, crude protein, fiber and the nitrogen-free extract was evaluated. 23.87±1.24% moisture is present in goldenseal root powder. 12.62±0.13% ash is present in goldenseal root while 22.81±0.09% of carbohydrates are

present in goldenseal root. 12.89±0.08%, 12.72±0.57%, and 15.61±0.02% of crude protein, crude fat, and crude fiber are present in goldenseal root powder. Values of proximate analysis for goldenseal root are shown in table 1.

Phytochemical characters of goldenseal root powder

Goldenseal root powder carried a significant amount of TPC and TFC depicted in fig. 1. Total phenolic content (TPC) was 514.27±0.02ug GAE/ml and total flavonoid content (TFC) was 334.87±0.11ug CE/ml.

Mineral analysis

Mineral analysis was performed via atomic absorption spectrophotometer for Ca, Zn, Fe, Mg, Mn K and Na. Mean ± S.D for sodium (77.21±9.32), potassium (139.84±15.74), zinc (21.20±1.69), magnesium (23.17±1.52), calcium (12.39±0.09), manganese (1.30± 0.05) and iron (2.04±0.87) were determined.

Table 1: Proximate analyses of goldenseal root powder

Proximate analysis	Composition (%)
Moisture	23.87±1.24
Ash	12.62±0.13
Nitrogen Free Extract	22.81±0.09
Crude protein	12.89±0.08
Crude Fat	12.72±0.57
Crude fiber	15.61±0.02

Table 2: Mean±S.D for Serum Uric Acid Level of Male Subjects in mg/dL.

Duration	G ₀	G ₁	G ₂
0 week	6.51±0.71	6.87±1.21	6.63±1.57
8 th week	6.88±1.61	6.51±1.07	5.02±1.23

G₀ = No Treatment, G₁= 5mg/kg of the body weighing goldenseal root powder G₂= 10mg/kg of the body weighing goldenseal root powder. Results were taken significant at p<0.05.

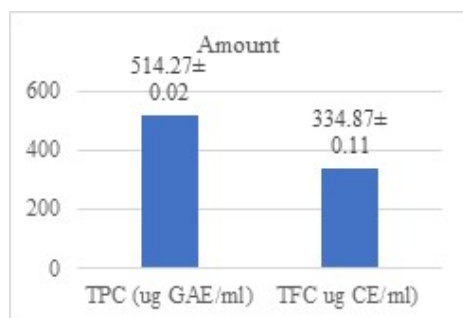


Fig. 1: Phytochemical analysis of goldenseal root powder

Investigation of therapeutic potential of goldenseal root powder for uricemia in female subjects

The objective of this study was to investigate the medicinal effect of goldenseal root powder on uricemia. Participants of the control group (G₀) were given no treatment while participants of treatment groups G₁ and

G₂ were given encapsulated doses of goldenseal root powder 5mg and 10mg per kg of the body weight respectively for 8 weeks. Before the commencement and after the standstill of the trial, blood samples were gathered from each subject for analysis of uric acid level.

Changes in uric acid level of female subjects

The investigation showed a significant (p<0.05) reduction in uric levels in response to goldenseal root powder capsules in both treatment groups at 8th week as compared to 0th week. Treatment group G₁ showed a reduction in the serum uric acid level from 6.87±1.21 mg/dl to 6.51±1.07 mg/dl while treatment group G₂ showed a reduction in serum uric acid level from 6.63±1.57 mg/dl to 5.02±1.23 mg/dl. However, between treatment group, G₂ showed a higher reduction in uric acid levels than treatment group G₁. However, the control group showed a slight increase in uric acid level levels.

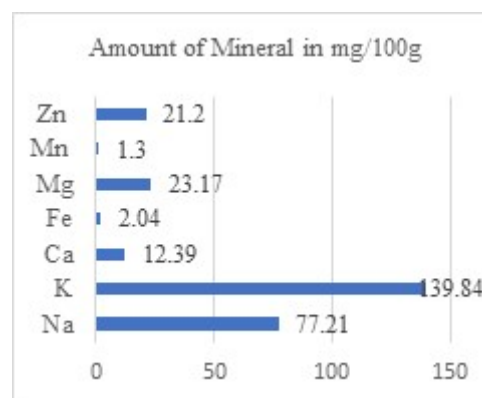


Fig. 2: Mineral analysis of goldenseal root powder.

DISCUSSION

Drug–drug and herb–drug pharmacokinetic interactions have compromised the safety of immunosuppression in renal transplant patients. Physicians know of synthetic drugs (e.g. calcium antagonists) and the two natural products grape- fruit juice (GFJ) and St John’s Wort (SJW) as modifiers of the bioavailability of the key immunosuppressive drugs cyclosporin and tacrolimus. SJW and GFJ are usually the only natural triggers of drug interactions listed along with synthetic drugs in text books and drug package inserts. These principal elements of xenobiotic metabolism might also be modified by other phytochemicals in foods and herbal drugs.

In this study therapeutic effect of goldenseal root powder was investigated. Moreover, proximate analysis, mineral determination and phytochemical analysis of goldenseal root powder were also determined. Proximate analysis helped researchers in chemical characterization and quality determination of raw materials. The proximate values of this study, for goldenseal root powder, were consistent with the proximate values of previous studies

in the literature. Minor differences were present in value which can be due to differences in environmental conditions, the efficacy of chemicals used, or due to location. Mineral analysis showed the presence of minerals in the mentioned amounts in fig. 2. These findings were consistent with the values of previously existing literature. Sodium and potassium were majorly present minerals in goldenseal root powder. Phytochemical analysis showed the presence of phenolic and flavonoid content. These phytochemicals were useful in reducing oxidative stress in the body and reducing uric acid levels (Weber *et al.*, 2003). Goldenseal root reduced the elevated uric acid levels. Both doses showed a reduction in serum uric acid levels. This was due to the phytochemicals present in goldenseal root powder. This effect of goldenseal powder for uricemia was also due to mineral composition. Goldenseal root contained alkaloids that contain anti-uremic properties which were also validated by previous literature (Cecil *et al.*, 2011). This was also supported by another study that alkaloids inhibit xanthine oxidase activity which was helpful in lowering elevated uric acid levels. However, in this study isolated alkaloids were used not whole golden seal root powder (Sidik *et al.*, 2022).

CONCLUSION

Goldenseal root is a medicinal plant that contains many important phytochemicals. Goldenseal root is anciently used by native Americans for many therapeutic properties. It is also used for flavoring and coloring properties as well. Goldenseal root powder contained vital minerals including sodium, potassium, magnesium and zinc. Sodium and potassium are important in transport of materials across the membranes. Goldenseal root powder contained an important phytochemical profile that show antioxidant properties. These phenols and flavonoids have the potential to reduce elevated uric acid. The study concluded that goldenseal root powder supplementation can be a therapeutic approach to manage elevated uric acid and associated symptoms including inflammation at joints and oxidative stress.

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