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Chemical Analysis on Shwetha Palandu (White Onion) Arka Eye drops in Cataract

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Abstract

Onion is a common vegetable used in cooking throughout the world. Bulbs may vary in size from a walnut to a large orange; color varies according to the variety, white, yellow and red. Its taste is very acrid and pungent; on cutting the oil volatilizes causing irritation of eyes and tearing. Onions are used for treating many symptoms and aliments. The anti-inflammatory compounds in onions can help reduce inflammation in the eyes, which is associated with cataract development. Research indicates that diets rich in fruits and vegetables, including onions, are associated with a reduced risk of cataracts. The therapeutic uses of onion have been described from various research studies. The preparation on eye drops is done by simple distillation method. The chemical composition of distillation of white onion with gas chromatography has been described in this paper.

Introduction

Allium cepa L. (Amaryllidaceae) is the most widely cultivated species of the genus *Allium*. The plant portion commonly used is the bulb, which is utilized as a food ingredient to give flavour and aroma to a great variety of dishes. Onions are an important source of several phytonutrients as flavonoids, fructo oligosaccharides (FOS), and thiosulfinates and other sulfur compounds, recognized as important elements of the Mediterranean diet. In fact, onions contain high levels of phenolic compounds, which have antioxidant properties besides beneficial effects against different degenerative pathologies (cardiovascular and neurological diseases, dysfunctions based on oxidative stress). Flavonoids are the major phenolics in onions, which can be classified to different subclasses (flavones, flavanones, flavonols, isoflavones, flavanonols, flavanols, chalcones, and anthocyanins) on the basis of the degree of unsaturation and the degree of oxidation of the central ring. Flavonols are the most abundant in onions, present as their glycosides, that is, quercetin and kaempferol in higher concentration (280–400mg/kg) than other vegetables. Anthocyanins, belonging to anthocyanidins, are mainly present in red onions (250mg/kg), besides having a composition rich in flavonols as yellow onions. FOS represents another source of phytochemicals in onions bulbs. They are mainly inulin, kestose, nystose, and fructo furanosylnystose. The health benefits of these carbohydrates have been widely reported in the past years due to their prebiotic effect. [1]

Vernaculars: English.: Onion; Urdu.: Piyaz; Hindi.: Duk, Kanada, Piyaz; Sanskrit.: Durgandha, Platandu; Bengali.: Gundhun, Palandu, Piyaj, Piyang, Pulantic, Pulantu; Malayalam.: Bawang, Cheriya ulli, Chuvanna ulli, Eerulli, Ira-venyayam; Marati.: Kanda, Kande; Tamil.: Ira-vengayam, Irulli, Ulli, Ullegaddi, Vengayam; Telugu.: Neermulli, Nirulli, Vulligaddalu, Yerragadda, Yerra-vulli, Vellulli;

Ara.: Basal; Chinese.: 火葱, Cong tou, Huo cong, Tsung, Yáng cōng, Yuan cong; Cze.: Šalotka; Dan.: Skalotteløg; Dut.: Sjalotten, Ui; Fin.: Šalottisipuli, Shalottisipuli; French.: Ail oignon, Ciboule, Echalote, Oignon, Oignon des jardins, Oignon patate; German.: Aschlauch, Bolle, Gewöhnliche, Hauszwiebel, Kartoffelzwiebel, Klöben, Küchenzwiebel, Sommerzwiebel, Zwiebel; Greek.: Askalonio; Haw.: Akaakai, Kikania; Ita.: Cipolla, Cipollina, Scalogna, Scalogno; Jap.: Sharotto, Tamanegi, Wakegi; Kor.: Eonieon, Onieon, Yangpa; Maly.: Brambang (Java); Nep.: Chyaapii; Nor.: Sjalott-løk; Per.: Goondina, Mousir, Piazcheh; Por.: Cebola miúda, Cebolha roxa, Cebolinha branca; Rus.: Shalot; Spa.: Ascalonia, Cebolla, Chalota, Escalma, Escalona; Tag.: Sibuyas; Tha.: Dton hom bua; Tur.: Soğan; Vie.: Hành, Hành tăm, Hành tím.

Phytoconstituents: Onion bulbs are among the richest sources of dietary flavonoids and contribute to the overall dietary intake of flavonoids. [2] Most important sources of flavonoids are tea (48% of total intake), onions (29%), and apples (7%). Yellow onions contain 270–1,187 mg of flavonols (flavonoids) per Kg of fresh weight (FW), whereas red onions contain 415–1,917 mg of flavonols per Kg of FW. Flavonols are the predominant pigments of onions[3] ; peel is also rich in flavonol contents which are 103 ± 7.90 µg/g dry weight (red variety) and 17.3 ± 0.69 µg/g dry weight (white variety).[4] Red onions contain significant amount of quercetin, the polyphenolic flavonoid credited for its 5-LOX inhibitory activity. [5] Sulphur containing compounds in onion are responsible to enhance blood fibrinolysis, without depressing fibrinogen content in human volunteers; one sulphur-containing but nearly odorless compound possesses indirect fibrinolytic potentials. [6] Fig :1

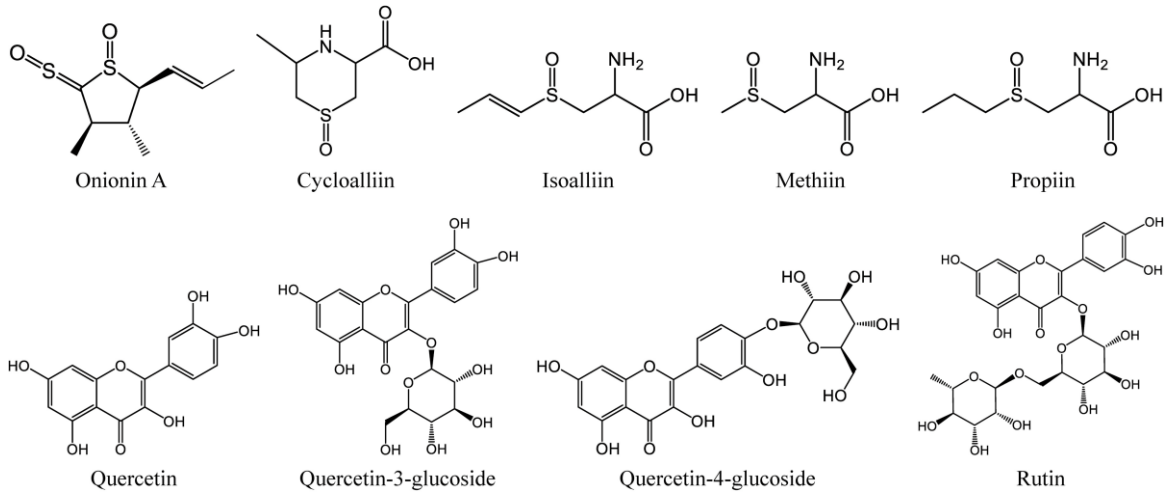


Fig: 1|The chemical structures of the main organo sulfur and phenolic compounds in onion.

Pharmacology: Therapeutic uses of Onion

Fresh whole onion extract to rabbits for six-months along with cholesterol (0.5%) significantly lowered total lipids, cholesterol and phospholipids levels in the eye. [7] Organo sulfur compounds, including S-methylcysteine and flavonoids, such as quercetin are also responsible for the hypoglycemic activity of onions. S-methylcysteine and flavonoids decrease levels of blood glucose, serum lipids, oxidative stress, and LPO, and increase activities of antioxidant enzymes, and insulin secretion.[8]

Anti-inflammtory properties of onion extracts are suggested to be due, in part, to the inhibition of inflammatory cell influx by thiosulfinates and capaenes.[9] Onion extracts were bactericidal to S. mutans and S. sobrinus, the causal bacteria for dental caries, and P. gingivalis and P. intermedia that cause adult periodontitis; however, the activity was lost after boiling the onion.[10] Supplementation with

hydroethanol onion extract significantly improved muscle coordination and memory deficits, reduced oxidative stress, brain AChE level, and decreased abnormal aluminium deposition in brains of aluminium exposed mice for 60-days. [11]

The ***Allium cepa*** is cultivated throughout India. Onion bulb and leaves are the important part of diet. Ether soluble fraction of onion (0.25mg/kg, orally) has been exhibited potent antioxidant activity which show anti cataract properties. [12] The instillation of onion juice into the rat eyes can effectively prevent selenite-induced cataract formation. This effect was associated with increased TA level, SOD and GPX activities in the lens.[13]

Masi of Allium cepa when used as Anjana can help in prevention of cataract and improve vision. According to Ayurveda, Palandu (Allium cepa) is of Katu Rasa, Anushnaveerya, Madhuravipaka and Vataghna. Anjana prepared from white onions in a very simple manner at home can help in the prevention of cataract. Onions are considered to be beneficial to the eye as they have sulphur which improves the lens; onions stimulate the production of a protein namely glutathione often referred as "the mother of all antioxidants "- which reduces the risk of cataract. Quercetin, a flavonoid found in onions reduces the risk of cataract. Selenium, an essential micronutrient found supports Vit E in eye. And Nitya Anjanaprayoga as essential part of Dinacharya can have a vast impact in the prevention of the condition. Due to its Katurasa it subsides the excessive Kaphadosha and normalizes the Alochaka pitta. Also due to its Vataghnaguna it subsides the Vatadosha. According to Modern medicine, it stimulates the production of a protein named glutathione, which acts as an antioxidant. Higher levels of glutathione help in reducing the risk of glaucoma, macular degeneration, and cataracts.

The selenium in onions supports the vitamin E which protects the cells in the eye. The sulphur in onions improves the health of the lens. Gutikanjana explained by Acharya Sushruta in Uttarasthana in the context of eye diseases includes Palandu as one of the ingredients. Nowadays, Palandumasi Anjana is used by many Ayurvedic as well as folklore practitioners in preventing the cataract. It has been found helpful in preventing the symptoms of cataract like blurred vision, double vision and sensitivity to light as observed in this patient. [14] Palandu which is Kaphahara, Drushti Saktivardhaka and good in Drstimandya was taken for the study as Lekhana eye drop.

Table:1 Properties of Palandu

Sanskrit	Botanical Name	Part Used	Properties	Doshaghna [15]
Shwetha Palandu	***Allium Cepa (white variety)***	Bulb	Katu, Madhura rasa, Guru Snigdha, Tikshna Guna, Isat UsnaVeerya	Vata Kaphahara, Good in Drishtimandyahara

Sulfur in onion improves the health of eye lens. It stimulates the production of a protein named Glutathione, which act as an antioxidant. Higher level of Glutathione reduces the risk of lens degeneration. White onion contains higher amount of Sulfur content than other varieties and hence white onion was taken for study. [16]

An animal study was done to know the effects of onion (*Allium cepa*) juice on the normal flora of conjunctiva and eye lids, and to follow the histopathology changes of conjunctiva in animal model.

Twenty-four rabbits were received fresh red onion juice, as an eye drop, into the right eye twice daily for; one week, one month, and two months. Microbiological sampling by sterile swabs was performed before and after the intervention. After the intervention, the number of positive cultures in the samples, collected from both the conjunctiva and eyelid, had decreased. According to the experiment, onion has an inhibitory effect on the growth of normal eye flora; although the duration of onion juice instillation did not show any significant effect on the group results. Hence, this finding is an initiating point for further investigations into the antimicrobial properties of this herb to treat common eye infections, including conjunctivitis and blepharitis. [17]

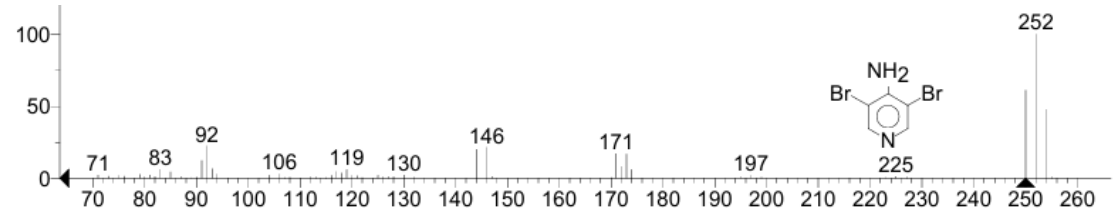
Onions contain Sulfur compounds which are responsible for the distinctive smell and taste of onions. Allicin is produced when the onion is cut or crushed, leading to its pungent aroma. Thiosulfates contribute to the flavor and health benefits. Onions are rich in flavonoids, particularly quercetin, which has antioxidant properties and may help reduce inflammation. Onions are a good source of vitamins C and B6, as well as minerals like potassium and manganese. Phenolic Compounds in onion have antioxidant properties and may contribute to various health benefits. Onions may have a protective role against cataracts due to their rich content of antioxidants, particularly quercetin and vitamin C. Studies have shown that the antioxidants in onions, particularly quercetin, can protect against oxidative stress, which is a contributing factor to cataract formation. Vitamin C: Onions contain vitamin C, which is known to support eye health. Adequate vitamin C intake is linked to a lower risk of cataracts, as it helps maintain the health of the lens. Anti-Inflammatory Effects: The anti-inflammatory compounds in onions can help reduce inflammation in the eyes, which is associated with cataract development. Dietary Patterns: Research indicates that diets rich in fruits and vegetables, including onions, are associated with a reduced risk of cataracts. One study published in the journal *Ophthalmology* found that higher intake of onions correlates with lower cataract risk.

Onion contains polyphenols, flavonoids, flavanols, anthocyanins, tannins and ascorbic acid. The list of compounds was identified using Gas Chromatography-Mass Spectrometry (GCMS). These are the volatile components of the eye drops. .GCMS method used are_Oven Temp-300°C, Inlet Temp-225°C, MSD Temp, Setpoint Quad-150°C, Setpoint Source-230°C, Helium Inlet Pressure-51.248 Kpa, Inj Vol-2 µl, Column- DB-WAX- 30mts Length, ID-250 µm, Film Thickness-0.5 µm. There is no presence of alkaloids in the sample.

Method of preparation of eye drops was by Simple Distillation method. White onions were cleaned and the external scaly layer was removed. They were crushed and transferred into *Arka Yantra* and was boiled. The vapors were condensed and collected in a receiver which contains the essential principle of onion.

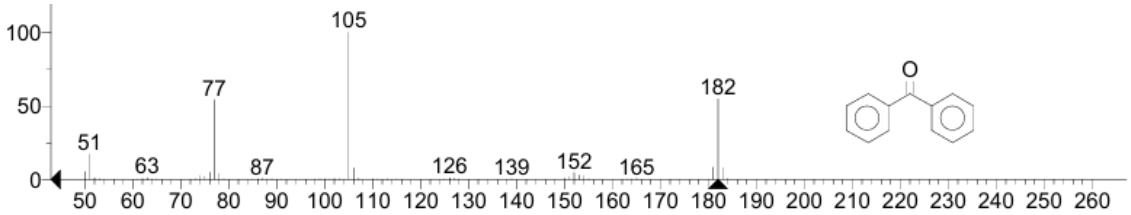
The following are the chemical compounds found out in Swetha Palandu Eye Drops.

1. **Name: 4-Pyridinamine, 3, 5-dibromo, Formula: C5H4Br2N2** - Certain compounds in this category may exhibit anti-inflammatory effects, which could be reducing inflammation in the eyes, which is associated with cataract development.



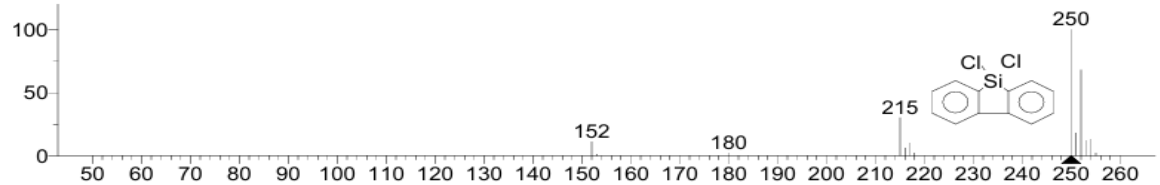
(mainlib) 4-Pyridinamine, 3,5-dibromo-

2. **Name: Benzophenone, Formula: C13H10O** -It is primarily known for its role as a UV filter in sunscreens and other cosmetic products. Benzophenone effectively absorbs UV radiation, which is a known risk factor for the development of cataracts. By blocking harmful UV rays, benzophenone may help reduce the risk of UV-induced cataract formation. Chronic UV exposure can lead to oxidative stress in the lens of the eye, contributing to cataract development. Benzophenone's antioxidant properties could theoretically help mitigate oxidative damage, although this aspect requires more research.



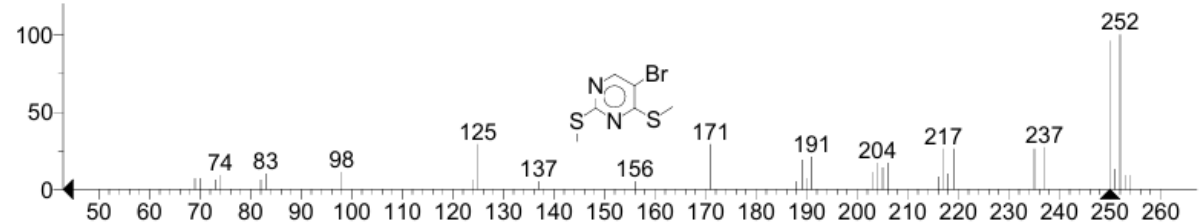
(replib) Benzophenone

3. **Name: 9, 9-Dichloro-9-silafluorene, Formula: C12H8Cl2Si**



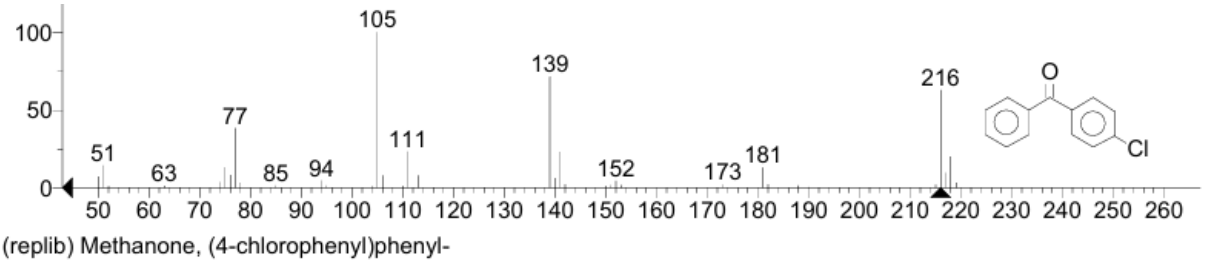
(mainlib) 9,9-Dichloro-9-silafluorene

4. **Name: Pyrimidine, 5-bromo-2, 4-bis(methylthio), Formula: C6H7BrN2S2** - Pyrimidine derivatives in general are widely studied in medicinal chemistry, including for their roles as antiviral, anticancer, and antibacterial agents.



(mainlib) Pyrimidine, 5-bromo-2,4-bis(methylthio)-

5. **Name: Methanone, (4-chlorophenyl) phenyl, Formula: C13H9ClO**

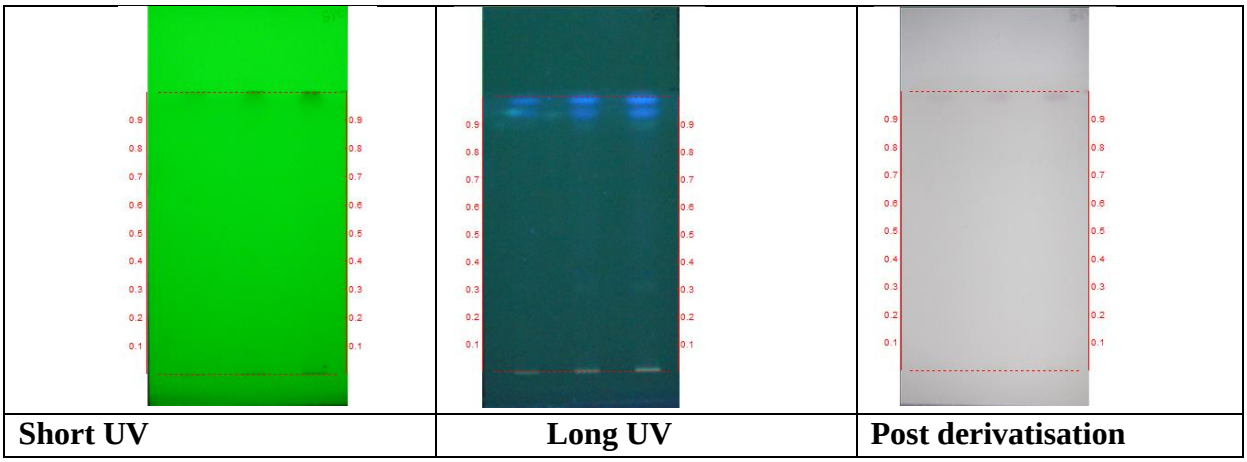


(replib) Methanone, (4-chlorophenyl)phenyl-

6. HPTLC report

Shwetha palandu eye drop 10.ml was partitioned with 10.0ml of chloroform kept overnight and seperated. 4, 8 and 12µl of each of the above extract were applied on a pre-coated silica gel F_{254} on aluminum plates to a band width of 7 mm using Linomat 5 TLC applicator. The plate was developed in **Toluene: Ethyl acetate: formic acid (5.0: 4.0: 1.0)**. The developed plates were visualized in short UV, long UV and then derivatised with vanillin sulphuric acid and scanned under UV 254nm, 366nm and 620nm (After derivatisation). R_f, colour of the spots and densitometric scan were recorded.

Fig 2. HPTLC photo documentation of chloroform fraction of *Shwetha palandu eye drop*



Short UV	Long UV	Post derivatisation

Solvent system – Toluene: Ethyl acetate: formic acid (5.0: 4.0: 1.0)

Track 1 – ***Shwetha palandu eye drop*** – 4µl

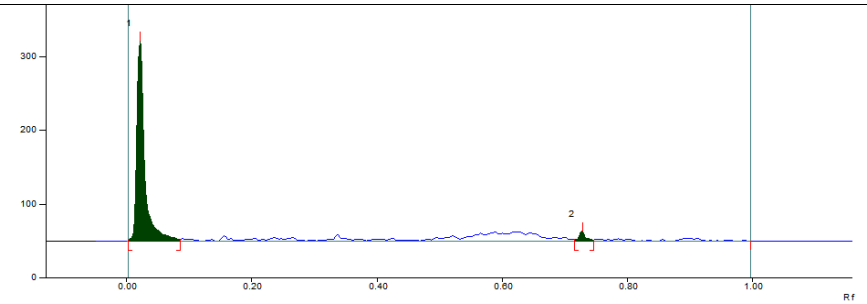
Track 2 – ***Shwetha palandu eye drop*** – 8µl

Track 3 – ***Shwetha palandu eye drop*** – 12µl

Table 2: R_f values of *Shwetha palandu eye drop*

Short UV	Long UV	Post derivatisation
-	**0.30 (F. blue)**	-
-	**0.36 (F. blue)**	-
-	**0.89 (F. blue)**	-

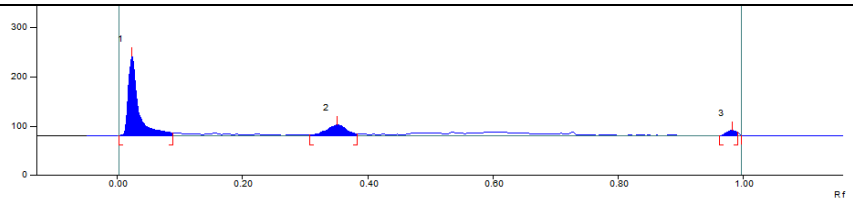
Figure 3. Densitometric scan *Shwetha palandu eye drop*



Track 3, ID: Shwetha palandu eye drop

Peak	Start Position	Start Height	Max Position	Max Height	Max %	End Position	End Height	Area	Area %
1	0.00 Rf	0.9 AU	0.02 Rf	271.2 AU	95.42 %	0.09 Rf	2.7 AU	2400.2 AU	95.93 %
2	0.72 Rf	2.6 AU	0.73 Rf	13.0 AU	4.58 %	0.75 Rf	1.7 AU	101.8 AU	4.07 %

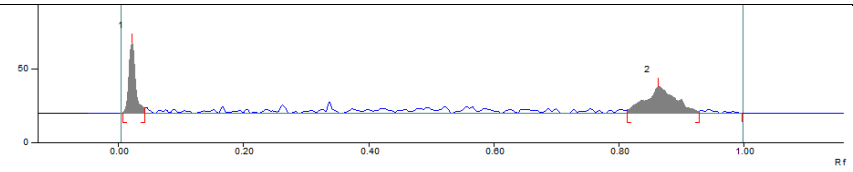
At 254nm



Track 3, ID: Shwetha palandu eye drop

Peak	Start Position	Start Height	Max Position	Max Height	Max %	End Position	End Height	Area	Area %
1	0.00 Rf	0.4 AU	0.02 Rf	162.5 AU	82.78 %	0.09 Rf	5.3 AU	1870.3 AU	74.45 %
2	0.31 Rf	1.2 AU	0.35 Rf	22.5 AU	11.48 %	0.38 Rf	3.7 AU	521.4 AU	20.75 %
3	0.96 Rf	0.0 AU	0.98 Rf	11.3 AU	5.74 %	0.99 Rf	6.5 AU	120.5 AU	4.80 %

At 366nm



Track 3, ID: Shwetha palandu eye drop

Peak	Start Position	Start Height	Max Position	Max Height	Max %	End Position	End Height	Area	Area %
1	0.01 Rf	0.3 AU	0.02 Rf	47.7 AU	72.41 %	0.04 Rf	3.6 AU	350.7 AU	36.04 %
2	0.81 Rf	2.2 AU	0.86 Rf	18.2 AU	27.59 %	0.93 Rf	1.5 AU	622.3 AU	63.96 %

At 620nm

HPTLC photo documentation, Rf values, densitometric scan of Shwetha palandu eye drop was carried out for identification of Quercetin which could be identified at 0.67±0.6.

Quercetin is a flavonoid found abundantly in onions, known for its antioxidant, anti-inflammatory, and antiviral properties. Quercetin, with its strong antioxidant properties, can help neutralize free radicals that contribute to this oxidative damage, thereby slowing or preventing the formation of cataracts. Quercetin has been shown to inhibit this glycation process, protecting lens proteins from sugar-induced damage, and thereby reducing the risk of cataract development, especially in diabetic patients. Quercetin has been found to **inhibit aldose reductase**, thereby reducing sorbitol buildup in the lens and protecting against cataract formation. Quercetin antioxidant properties can help protect the lens from UV-induced oxidative damage, potentially reducing the risk of cataracts caused by excessive sun exposure. Quercetin from onions shows promise in cataract prevention by protecting the lens from oxidative damage, inhibiting protein glycation, and reducing sorbitol accumulation.

Conclusion

Onion is widely used in different therapeutic conditions throughout the world. The anti-inflammatory properties and antioxidant properties of onion help in treating cataract. Onion contains polyphenols, flavonoids, flavanols, anthocyanins, tannins and ascorbic acid. The list of compounds was identified using Gas Chromatography-Mass Spectrometry (GCMS). Onion contains quercetin which is flavonoids which helps in antioxidant and anti-inflammatory property. Quercetin has been found to inhibit aldose reductase, thereby reducing sorbitol buildup in the lens and protecting against cataract formation. Benzophenone present in onion may help reduce the risk of UV-induced cataract formation by blocking harmful UV rays. Benzophenone antioxidant properties could theoretically help mitigate oxidative

damage. More advanced research work is needed for understanding the penetration of Shwetha Palandu eye drops to reduce cataract.

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