

## " Isolation and evaluation of piperine from Black pepper and white pepper"

Yadav, A., Wagh, P.

Department of Chemistry, B N Bandodkar College of Science (Autonomous), Thane  
[aartiivadav09@gmail.com](mailto:aartiivadav09@gmail.com), [\\*pswagh@vpmthane.org](mailto:pswagh@vpmthane.org)

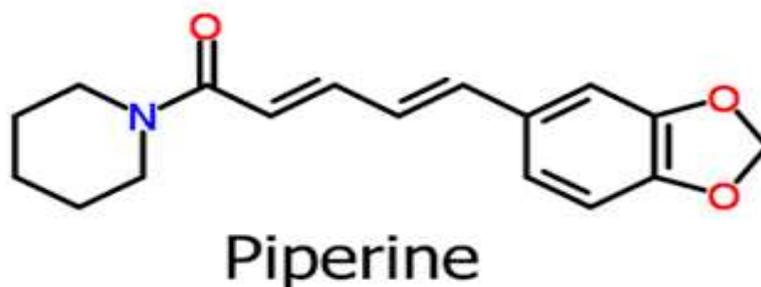
### ABSTRACT:

Piperine is a naturally occurring alkaloid responsible for the pungency of black pepper (*Piper nigrum*) and white pepper. In the present work, piperine was isolated from black and white pepper using chloroform solvent extraction followed by recrystallization. The isolated compound was evaluated using melting point determination, Thin Layer Chromatography (TLC) and UV-Visible spectroscopy. Comparative results showed higher piperine yield from black pepper than white pepper. UV-Visible spectral analysis confirmed the characteristic absorption maxima of piperine, indicating successful isolation.

### INTRDUCTION :

Among all spices, black pepper is well known as a distinctive spice worldwide. It is also known as the 'King of spices'. It has a distinctive pungent flavor due to the presence of an alkaloid piperine, along with volatile oils, and essential oils[1-5]. The content of piperine varies from plant to plant belonging to the Piperaceae family and varies from 2% to 7.4% in vines of black and white pepper (*piper nigrum*). However, certain reports suggest a higher content of piperine up to 9% in black pepper and 4-5% in long pepper (*piper longum*). The amount of piperine content can be influenced by modifications in conditions of cultivation such as drying conditions and the place of origin[6-8]. Piperine, the most abundant pungent principle present in black pepper, was initially isolated in 1819 by Hans Christian Orsted. He extracted a yellow crystalline material having molecular formula  $C_{17}H_{19}NO_3$  with a melting point of 128-130°C. Later, the chemical structure was elucidated, and its IUPAC name is (2E, 4E)-5-(benzo[d][1,3]dioxol-5-yl)-1-(piperidin-1-yl)penta-2,4-dien-1-one.

The chemical structure of piperine is shown in Figure 1



**Figure 1.** structure of piperine

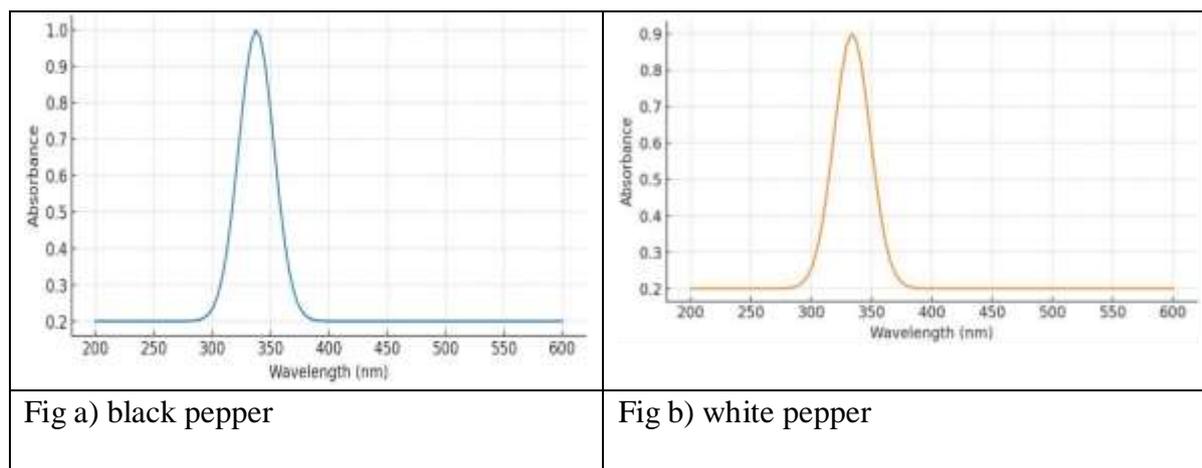
Black pepper and white pepper were selected for comparative extraction because processing differences significantly influence the piperine content. Black pepper retains the outer pericarp layer, which contains a higher concentration of alkaloids, whereas white pepper undergoes removal of the outer layer during processing, which may reduce the piperine content. The importance of this research lies in evaluating a simple laboratory-scale isolation method and comparing the yield of piperine from two commonly used spice forms[9]. Piperine is pharmacologically important due to its bioavailability-enhancing, antioxidant, and anti-inflammatory properties.

#### **EXPERIMENTAL Materials and Methodology :**

Black and white peppercorns (*Piper nigrum*): Source of piperine, Solvents: Ethanol, Dichloromethane, Hexane, Reagents: Silica gel, Chloroform, Methanol, Instrumentation: UV-Vis Spectrophotometer. Chloroform was used as the primary extraction solvent for the isolation of piperine. Collection and Preparation of Sample: Black pepper and white pepper samples were procured from a reliable source. The samples were converted into powdered form (100 g each) and subjected to reflux extraction using chloroform for 3 hours. The mixture was heated at 60–80°C for 3–4 hours. Reflux ensured continuous extraction by preventing solvent evaporation. After reflux, the mixture was cooled and filtered to remove solid residue. The extract was filtered to remove solid residues. After filtration, the filtrate was allowed to stand overnight in the refrigerator. Later, the formed yellow crystalline solid was separated from the solution by vacuum filtration. The crystals were recrystallized in hot ethanol, cooled slowly and filtered to obtain pure piperine. If necessary, thin-layer chromatography (TLC) was used for further purification. Thin Layer Chromatography (TLC) was performed using silica gel plates as the stationary phase and chloroform:methanol (9:1) as the mobile phase for purity assessment.

#### **RESULTS AND DISCUSSION :**

The isolated piperine was characterized by melting point determination, Thin Layer Chromatography (TLC) and UV – Visible spectroscopy. TLC showed a single spot with an R<sub>f</sub> value comparable to reported piperine, indicating purity. UV – Visible spectroscopy exhibited characteristic absorption maxima corresponding to piperine, confirming the successful isolation and identity of the compound of black pepper and white pepper as shown in figure a and figure b respectively.



The extraction process obtained the crystalline piperine from both black and white pepper have been checked with the observed yield. It is observed that the yield obtained from black pepper was higher than that from white pepper. The percentage yield of piperine obtained from black pepper was 6.5%, whereas white pepper yielded 3.8%. [10] TLC analysis showed a single spot, indicating purity of the isolated compound. TLC of the isolated sample was compared with standard piperine and showed comparable  $R_f$  values, confirming the successful isolation of piperine. The melting point was found to be in agreement with reported literature values. The observed melting point was 128–130°C, which is consistent with the reported literature value [11], confirming the identity and purity of the isolated compound. UV–Visible spectroscopy showed characteristic absorption maxima corresponding to piperine, confirming its identity.

#### CONCLUSION :

Piperine was successfully isolated from black and white pepper using a simple solvent extraction method. Black pepper was found to be a richer source of piperine compared to white pepper. UV–Visible spectroscopic analysis confirmed the identity of the isolated compound. The adopted method is simple and suitable for laboratory-scale studies.

#### ACKNOWLEDGEMENT :

Authors would like to acknowledge the Department of Chemistry, VPMs B N Bandodkar College of Science (Autonomous), Thane for providing the laboratory facilities and equipment required for this study. We sincerely thankful to Principal of VPMs B N Bandodkar College of Science (Autonomous), Thane for allowing us to perform this research and all support. We acknowledge the library of VPMs B N Bandodkar College of Science (Autonomous), Thane for granting access to its archives and extensive collection of resources, which were essential for this study.

**REFERENCES :**

- [1] Chopra B, Dhingra AK, Kapoor RP, Prasad DN. Piperine and its various physicochemical and biological aspects: a review. *Open Chemistry Journal*. 2016;3(1):75–96.
- [2] Sozzi GO, Peter KV, Babu KN, Divakaran M. Capers and caperberries. In: Peter KV, editor. *Handbook of Herbs and Spices*. Vol. 2. Elsevier/CRC Press; 2012. p. 193–224.
- [3] Pruthi JS. *Quality assurance in spices and spice products: modern methods of analysis*. New Delhi: Allied Publishers Ltd.; 1999. ISBN: 9788170238966.
- [4] Ravindran PN. *Black pepper: Piper nigrum*. Boca Raton, FL: CRC Press; 2003. ISBN: 9789057024535.
- [5] Hirasu K, Takemasa M. *Spice Science and Technology*. Boca Raton, FL: CRC Press; 1998. ISBN: 9780824701444.
- [6] Kozukue N, Park MS, Choi SH, Lee SU, Ohnishi-Kameyama M, Levin CE, Friedman M. Kinetics of light-induced cis-trans isomerization of four piperines and their levels in ground black peppers as determined by HPLC and LC/MS. *Journal of Agricultural and Food Chemistry*. 2007;55(17):7131–7139.
- [7] Zachariah TJ, Parthasarathy VA. Black pepper. In: Parthasarathy VA, editor. *Chemistry of Spices*. Cambridge: Royal Society of Chemistry; 2008. p. 21–40. ISBN: 9781845934057.
- [8] Pruthi JS. *Major Spices of India: Crop Management and Post-Harvest Technology*. New Delhi: Indian Council of Agricultural Research; 1993.
- [9] Correa EA, Högestätt ED, Sterner O, Echeverri F, Zygmunt PM. In vitro TRPV1 activity of piperine derived amides. *Bioorganic & Medicinal Chemistry*. 2010;18(9):3299–3306.
- [10] Hlavačková L, Janegová A, Uličná O, Janega P, Černá A, Babál P. Spice up the hypertension diet — curcumin and piperine prevent remodeling of aorta in experimental L-NAME induced hypertension. *Nutrition & Metabolism (Lond)*. 2011;8:72.
- [11] Solubility of Piperine and Its Inclusion Complexes in Biorelevant Media and Their Effect on Attenuating Mouse Ileum Contractions, Toshinari Ezawa, Yukiko Inagaki, Kinami Kashiwaba, Namiko Matsumoto, Hajime Moteki, Isamu Murata, Yutaka Inoue, Mitsutoshi Kimura, Masahiko Ogihara, Ikuo Kanamoto, ACS Omega 2021, 6, 10, 6953–6964.